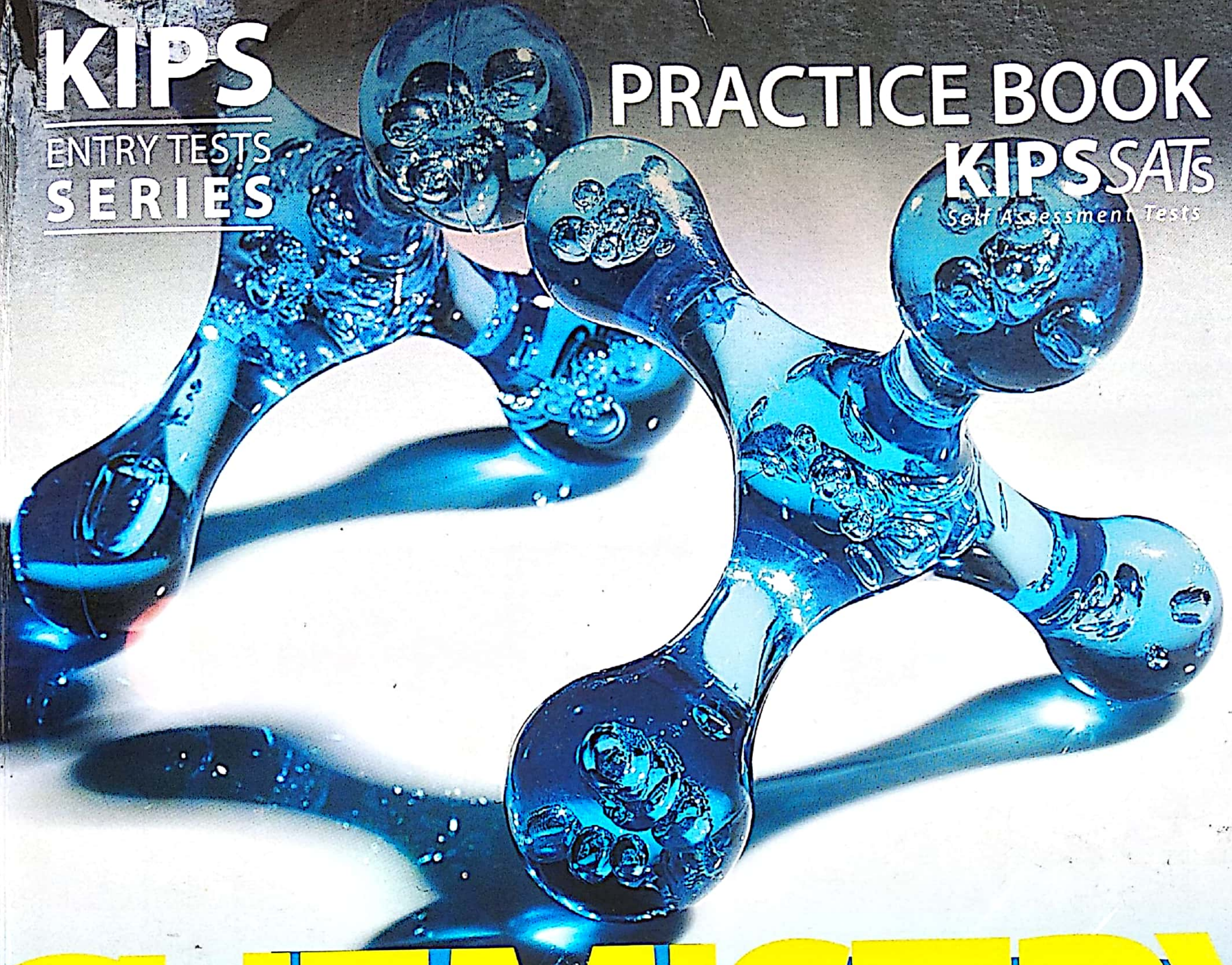
KIPS
ENTRY TESTS
SERIES

PRACTICE BOOK
KIPS SATs
Self Assessment Tests



CHEMISTRY

National MDCAT

AS PER PMC SYLLABUS

- 2077 Practice MCQs
- Questions from Past Papers
- Answer Keys with Explanatory Notes
- Topic-wise Practice Exercises
- Unit-wise Self Assessment Tests
- Pre-Prep Test (Diagnostic Test)
- Post-Prep Test
  (Sample Paper as per Original Format)

A Kitab Dost Publication

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KIPS SATs UNIT WISE

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- **This Pre Prep Assessment is designed to help you to pinpoint the weak areas in your background. Sit aside 1 hour to take this test. Check your answers with those at the**
- **end of the test. Then evaluate yourself.**

PRE-PREP ASSESSMENT

Q.1 **Which element has highest ionization energy?**

A. Li
B. B
[✓ C. Be]
D. Na

Q.2 **The mass of one mole of electrons is**

A. 1.008 mg
B. 0.184 mg
[✓ C. 0.55 mg]
D. 1.637 mg

Q.3 **The volume occupied by 1.4g CO at S.T.P is**

A. 22.4 dm^3
[✓ B. 1.12 dm^3]
C. 2.24dm^3
D. 112 cm^3

Q.4 **Enthalpy change of which compound cannot be measured directly**

A. CO_2
B. SO_2
C. NO_2
[✓ D. CO]

Q.5 **Which of the following set has isoelectronic species**

A. F^-, Cl^-, Br^-
[✓ B. F^-, Ne, Na^+]
C. Li^{+1}, Na^{+1}, K^{+1}
D. H^+, H^-, H

Q.6 **Number of electrons present in 1.6g of methane**

[✓ A. N_A]
B. $3N_A$
C. $2N_A$
D. $10N_A$

Q.7 **What can affect the magnitude of equilibrium constant K_p of a reversible gaseous reaction?**

[✓ A. Temperature]
B. Catalyst
C. Pressure
D. Concentration

Q.8 **The compound which only have London forces among its molecules**

A. HF
[✓ B. C_2H_6]
C. NH_3
D. H_2O

Q.9 **The preparation of H_2SO_4 by contact process is an example of:**

A. Autocatalysis
[✓ B. Heterogeneous catalysis]
C. Homogeneous catalysis
D. Enzyme catalysis

Q.10 **Identify polar molecular solid among the following**

[✓ A. Glucose]
B. Dry ice
C. Iodine
D. Sulphur

Q.11 Which of the following cannot be used as buffer solution

∝ [✓ A. $NH_4Cl + NH_4OH$]

[✓ B. $H_2SO_4 + NaHSO_4$]

C. $CH_3COOH + CH_3COONa$

D. $H_3PO_4 + NaHPO_4$

Q.12 A real gas obeying Van der Waal's equation will resemble the ideal gas if

✓ [✓ A. Both 'a' and 'b' are small]

B. 'a' is small and 'b' is large

[✓ C. Both 'a' and 'b' are large] ∝

D. 'a' is large and 'b' is small.

Q.13 Which of the following shows highest deviation from gas laws

[✓ A. N_2] ∝

B. H_2

✓ [✓ C. Cl_2]

D. He

Q.14 Unit of proportionality constant 'k' in Boyle's law

[✓ A. atm dm^3]

[✓ B. atm / dm^3] ∝

C. dm^3/ atm

D. $atm^{-1}dm^{-3}$

Q.15 The molecules of CO_2 in dry ice form

A. Ionic crystal

[✓ B. Molecular crystal]

C. Covalent crystal

D. Any type of crystal

Q.16 Which of the following has highest volatility

[✓ A. CH_3OCH_3]

B. $CH_2(OH)$-$CH_2(OH)$

C. C_2H_5OH

D. H_2O

Q.17 Only London dispersion forces are present among the

A. Molecules of water in liquid state

B. Atoms of helium in gaseous state at high temperature

C. Molecules of hydrogen chloride gas

[✓ D. Molecules of solid iodine]

Q.18 The order of reactivity of halogens with alkane is

A. $I_2 > Br_2 > Cl_2 > F_2$

B. $Cl_2 > F_2 > Br_2 > I$

[✓ C. $F_2 > Cl_2 > Br_2 > I_2$]

D. $I_2 > F_2 > Cl_2 > Br_2$

Q.19 Quantum number values for 3p orbitals are

A. n=3 l=2

[✓ B. n=3 l=1]

C. n=3 l=0

D. n=3 l=3

Q.20 Which of the following has half-filled 4s orbitals

[✓ A. Cr]

B. Mn

C. Sc

D. Mn

Q.21 After losing electron, sodium attains the nearest inert gas configuration of

A. He

B. Ar

[✓ C. Ne]

D. Kr

Q.22 H–N – H bond angle in NH_3 is

[✓ A. 107.5°]
B. 120°
C. 104.5°
D. 180°

Q.23 For a given process the heat changes at constant pressure (q_p) and at constant volume (q_v) are related to each other as

A. $q_p = q_v$
[✓ B. $q_p > q_v$]
C. $q_p < q_v$
D. $q_p = q_v/2$

Q.24 For which system does the equilibrium constant Kc has unit of (concentration)$^{-1}$

A. $N_2 + 3H_2 \rightleftharpoons 2NH_3$
[✓ B. $2NO_2 \rightleftharpoons N_2O_4$]
C. $H_2 + I_2 \rightleftharpoons 2HI$
D. $2HF \rightleftharpoons H_2 + F_2$

Q.25 Solubility product of AgCl is 2.0×10^{-10} mol^2 dm^{-6}. Maximum concentration of Ag^{+1} ions in the solution is

A. 2.0×10^{-10} mol dm^{-3}
B. 1.0×10^{-10} mol dm^{-3}
[✓ C. 1.414×10^{-5} mol dm^{-3}]
D. 1.0×10^{-20} mol dm^{-3}

Q.26 Empirical formula of acetic acid is

A. CH_3O
[✓ B. CH_2O]
C. CHO
D. C_2HO

Q.27 Which of the following has highest number of particles

[✓ A. 1g of Mg]
B. 1g of Fe
C. 1g of Al
D. 1g of Mn

Q.28 Stronger is the oxidizing agent, greater is the

A. Oxidation potential
B. E.M.F of cell
[✓ C. Reduction potential]
D. redox potential

Q.29 Which is most likely anode if Cu is selected as cathode

[✓ A. Zn]
B. Hg
C. Ag
D. Au

Q.30 Which is true about Zn-Cu galvanic cell?

A. Reduction occurs at anode
B. K^+ ion transfer from salt bridge to left beaker of $ZnSO_4$
C. Oxidation occurs at cathode
[✓ D. Anode is negatively charged]

Q.31 Which is the unit of (k) rate constant for zero order reaction

A. s^{-1}

B. $mol^{-1}\ dm^{3}\ s^{-1}$

[✓ C. $mol\ dm^{-3}\ s^{-1}$]

D. $mol^{-2}\ dm^{6}\ s^{-1}$

Q.32 Nitrates of which pair gives different products on thermal decomposition

A. Na, K

[✓ B. Li, Na]

C. Mg, Ca

D. Li, Ca

Q.33 22g of CO_2 occupies the volume

[✓ A. $11.212dm^3$]

B. $5.6dm^3$

C. $22.4dm^3$

D. $44.8dm^3$

Q.34 Keeping in view the size of atom, which is correct order

A. Mg > Sr

B. Lu > Ce

[✓ C. Ba > Mg]

D. Cl > I

Q.35 Which of the following have highest ionization potential

A. Na

B. Mg

C. S

[✓ D. P]

Q.36 Which of the following compounds of oxygen have cation with oxidation state of +1

[✓ A. X_2O]

B. X_2O_3

C. XO

D. X_3O

Q.37 Which of the following is not nucleophile

A. PH_3

B. H_2O

C. NH_3

[✓ D. BH_3]

Q.38 Cyano functional group is present in

[✓ A. Alkyl nitrile]

B. Primary amine

C. Alkyl halide

D. Acid amide

Q.39 Which molecule has the highest bond energy among the halogens

A. Fluorine

B. Iodine

[✓ C. Chlorine]

D. Bromine

Q.40 Identify the most basic oxide

[✓ A. Na_2O]

B. MgO

C. Al_2O_3

D. CO_2

Q.41 The most paramagnetic specie is

A. Fe^{+2}

B. Cr^{+3}

C. Co^{+2}

[✓ D. Mn^{+2}]

Q.42 In the complex $[Cr(OH)_3(H_2O)_3]$, the coordination number is

A. 2

B. 4

C. 3

[✓ D. 6]

Q.43 Pair of compound shows abnormal value of ionization energy

[✓ A. B, Al] B. N, H
C. Na, C D. Na, K

Q.44 A greater number of the organic compounds is due to all of following properties except

[✓ A. Tetravalency of carbon] B. Isomerism in organic compound
C. Catenation of carbon D. Carbon can form multiple bonds

Q.45 In 1- pentene -4- yne the carbon number 1,2,3 exhibit hybridization, respectively

A. $sp^3 – sp^2 – sp$ B. $sp^2 – sp – sp^3$
C. $sp^3 – sp – sp^2$ [✓ D. $sp^2 – sp^2 – sp^3$]

Q.46 Vinyl acetylene combines with hydrochloric acid produces

A. Divinyl acetylene [✓ B. Chloroprene]
C. Ethylidine dichloride D. 1,3,3-trichloro butane

Q.47 Electrophile in nitration of benzene

A. NO_2 [✓ B. NO_2^+]
C. NO D. CO

Q.48 When toluene reacts with chlorine in sunlight, the first major product is

[✓ A. Benzyl chloride] B. o-Chlorotoluene
C. Benzal dichloride D. o-Chlorotoluene and p-chlorotoluene

Q.49 Which one of the following will be readily sulphonated

A. Chlorobenzene B. Nitrobenzene
[✓ C. Toluene] D. Benzene

Q.50 Which one of the following is not a good leaving group

A. HSO_4^- [✓ B. OH^-]
C. Cl^- D. Br^-

Q.51 Which of the following is primary alkyl halide

[✓ A. Ethyl chloride] B. 2-Chloropropane
C. Iso-propyl chloride D. 2-Chloro-2-methyl propane

Q.52 The process of fermentation involves all the enzymes except

A. Diastase B. Zymase
C. Invertase [✓ D. Sucrase]

Q.53 Ethyl chloride on reduction in the presence of Zn/HCl produces

A. n-butane [✓ B. Ethane]
C. Ethanol D. Diethyl ether

Q.54 Which one does not exhibit aldol condensation

A. Ethanal [✓ B. Benzaldehyde]
C. Acetone D. Butanone

Q.55 For industrial preparation of CH_3CHO catalytic promoter is

A. $PdCl_2$ [✓ B. $CuCl_2$]
C. Cu_2Cl_2 D. $PbCl_2$

Q.56 **The common name of propane -1,3-dioic acid is**

A. Oxalic acid
[✓ B. Malonic acid]
C. Succinic acid
D. Fumaric acid

Q.57 **Which of the following is not a fatty acid**

A. Propanoic acid
[✓ B. Phthalic acid]
C. Acetic acid
D. Butanoic acid

Q.58 **Which of the following is most acidic**

[✓ A. HCOOH]
B. CH_3COOH
C. CH_3CH_2COOH
D. C_6H_5COOH

Q.59 **Which of the following structure of protein does not have hydrogen bonding**

[✓ A. Primary]
B. Tertiary
C. Secondary
D. Quaternary

Q.60 **Which of the following enzyme has Zn^{+2} ion as co-factor**

A. Chrome oxidase
B. Alkaline phosphatase
[✓ C. Chrome anhydrase]
D. Glucose 6-phosphatase

ANSWER KEY

1	C	11	B	21	C	31	C	41	D	51	A
2	C	12	A	22	A	32	B	42	D	52	D
3	B	13	C	23	B	33	A	43	A	53	B
4	D	14	A	24	B	34	C	44	A	54	B
5	B	15	B	25	C	35	D	45	D	55	B
6	A	16	A	26	B	36	A	46	B	56	B
7	A	17	D	27	A	37	D	47	B	57	B
8	B	18	C	28	C	38	A	48	A	58	A
9	B	19	B	29	A	39	C	49	C	59	A
10	A	20	A	30	D	40	A	50	B	60	C

Topic 1 INTRODUCTION TO FUNDAMENTAL CONCEPTS OF CHEMISTRY

PRACTICE EXERCISE

Q.1 **How many unstable radioactive isotopes have been produced through artificial disintegration**

A. 280
[✓ B. 300]
C. 40
D. 154

Q.2 **The total types of fundamental nuclear sub-atomic particles are there in an atom**

A. More than 100
B. 3
[✓ C. 2]
D. Equal to 100

Q.3 **Isotopes are**

[✓ A. Chemically similar]
B. Chemically dissimilar
C. Physically similar
D. Both 'A' and 'B'

Q.4 **Correct representation of element with atomic number and atomic mass is**

[✓ A. $^{A}_{Z}X$]
B. $^{Z}_{A}X$
C. $^{A}X^{Z}$
D. $^{Z}X^{A}$

Q.5 **Molecular ions are formed by passing**

A. High energy electron beam
B. α -particle
C. X-rays
[✓ D. All of the above]

Q.6 **Which one is true about isotope**

A. Same number of neutrons
B. Same mass number
C. Same physical properties
[✓ D. Same chemical properties]

Q.7 **Number of moles present in 0.6 gram of silica is (Atomic mass Si = 28, O = 16)**

[✓ A. 0.01 mole]
B. 0.044 mole
C. 0.064 mole
D. 0.054 mole

Q.8 **Volume occupied by 4.4g of CO_2 at STP is**

[✓ A. $2.24dm^3$]
B. $22.4dm^3$
C. $112cm^3$
D. $1.12\ dm^3$

Q.9 **Which one is the molar volume of the gas at STP?**

A. $24dm^3$
B. $80dm^3$
[✓ C. $22.4dm^3$]
D. $40dm^3$

Q.10 **Number of H^+ ions when 0.1 mole of sulfuric acid is completely ionized in water:**

A. $4 \times 6.022 \times 10^{23}$
B. $2 \times 6.022 \times 10^{23}$
C. $1 \times 6.022 \times 10^{23}$
[✓ D. $2 \times 6.022 \times 10^{22}$]

Q.11 **How many electrons have to be removed to ionize 1.0×10^{-6} moles of Ne atoms to Ne^+ ions in a neon advertising tube**

A. $\frac{6.02\times10^{23}}{1.0\times10^{-6}}$
[✓ B. $1.0 \times 10^{-6} \times 6.02 \times 10^{23}$]
C. $\frac{1.0\times10^{-6}\times6.02\times10^{23}}{20.2}$
D. $\frac{1.0\times10^{-6}\times6.02\times10^{23}}{9.65\times10^{-1}}$

Q.12 **When 0.5 moles of $Al_2(SO_4)_3$ are dissolved in water, total number of particles produced**

A. 1.2×10^{23}
[✓ B. 1.5×10^{24}]
C. 3.0×10^{23}
D. 2.5×10^{23}

Q.13 **Which of the following contains 1 mole of the stated particles?**

A. Chlorine molecules in 35.5 g of chlorine gas
B. Hydrogen ions in $1dm^3$ of $1mol\ dm^{-3}$ aqueous sulphuric acid
[✓ C. Electrons in 1g of hydrogen gas]
D. Oxygen atoms in $22.4\ dm^3$ of oxygen gas at STP

Q.14 **The number of moles of CO_2 which contain 16g of oxygen**
A. 0.25
[✓ B. 0.50]
C. 1.00
D. 1.50

Q.15 **The mass of one molecule of O_2 is**
A. $\frac{6.02\times10^{23}}{32}$
B. 0.32g
C. 32g
[✓ D. $\frac{32}{6.02\times10^{23}}$]

Q.16 **Amount of oxygen in grams which contains 1.5×10^{22} molecules**
A. 0.08
B. 80
[✓ C. 0.80]
D. 1280

Q.17 **Number of electrons in half mole of Na^+**
A. 10
B. 5
C. $5.5N_A$
[✓ D. $5N_A$]

Q.18 **3×10^{-21} moles of an amino acid having molecular mass 200 g mol^{-1}, would have molecules**
A. 200
B. 300
[✓ C. 1800]
D. 36000

Q.19 **The relative atomic mass of oxygen is 16amu. What is the mass of 2 mole of oxygen gas?**
[✓ A. 64g]
B. 100g
C. 32g
D. 71g

Q.20 **Which of the following has maximum mass**
A. 25g of iodine
[✓ B. 25g mole of water]
C. 25g atom of oxygen
D. 25g of nitrogen gas

Q.21 **Mass of one mole of chlorine gas is**
A. 32g
B. 35.5g
[✓ C. 71g]
D. 46g

Q.22 **Which of the following is not true for a mole?**
A. It is counting unit
B. It is the gram atomic or gram formula mass of a substance
C. It contains 6.023×10^{23} particles
[✓ D. It contains different number of particles for different substances]

Q.23 **During combustion analysis, which one is used for absorbing carbon dioxide**
[✓ A. 50 % KOH solution]
B. 5% KOH
C. $Mg(ClO_4)_2$
D. Silica gel

Q.24 **Absorption of CO_2 in KOH solution during combustion analysis is**
[✓ A. Chemical change]
B. Physical change
C. Neither chemical nor physical change
D. CO_2 absorbed in $Mg(ClO_4)_2$

Q.25 **Which of the following compounds has highest percentage of oxygen by weight**
A. CH_3OH
B. HCOOH
C. C_2H_5OH
[✓ D. H_2O]

Q.26 **Which of the following compound have empirical formula, but no molecular formula**
A. H_2O
B. C_6H_6
C. H_2O_2
[✓ D. NaCl]

Q.27 **The sole products of combustion analysis are**
A. CO_2 and NH_3
B. H_2O and $Mg(ClO_4)_2$
C. CO_2 and KOH
[✓ D. CO_2 and H_2O]

Q.28 **An acid with molecular mass 104 contain 34.6%C, 3.85% H and rest is O. The molecular formula of acid is**

[✓ A. $C_3H_4O_4$]
B. $C_2H_2O_4$
C. C_2H_2O
D. C_2HO

Q.29 $6Na + Fe_2O_3 \longrightarrow 3Na_2O + 2Fe$

For above reaction, if you are provided with 230g Na and 320g Fe_2O_3, then limiting reactant is

[✓ A. Na]
B. Na_2O
C. Fe_2O_3
D. None of these

Q.30 **Mg reacts with HCl as per the following reaction**

$Mg_{(s)} + 2HCl_{(aq)} \rightarrow MgCl_{2\,(aq)} + H_{2\,(g)}$

Given that; Mg = 21g and HCl=21g, the excess reactant is;

[✓ A. Mg]
B. HCl
C. Both are in stoichiometric amounts
D. None of these

Q.31 **What volume of oxygen is required for complete combustion of $5cm^3$ C_2H_2**

A. $2cm^3$
B. $5cm^3$
[✓ C. $12.5cm^3$]
D. $13.5cm^3$

Q.32 **$11.207dm^3$ of methane at STP has ________ moles of hydrogen atoms**

A. 4
[✓ B. 2]
C. 8
D. 16

Q.33 **How much Al is required to form alumina with 12g of oxygen**

A. 27g
[✓ B. 13.5g]
B. 54g
D. 24g

Q.34 **The actual yield is always less than the theoretical yield due to**

A. Side reaction
B. Reversible nature
C. mechanical loss
[✓ D. All of these]

Q.35 **Indicate the incorrect statement from the following**

A. A limiting reactant is consumed at the end of reaction
B. Actual yield is always greater than theoretical yield
[✓ C. Stochiometric calculation can be only done if no side reaction happens]
D. The empirical formula and molecular formula of some of compounds are same

Q.36 **The calculation of the efficiency of a chemical reaction can be checked by knowing the amount of**

A. The limiting reactant
B. The access reagent
[✓ C. The product formed]
D. The substance left unused

Q.37 **When one mole of each of the following is completely burnt in oxygen, which will give the largest mass of CO_2**

A. CO
[✓ B. Ethane]
C. Diamond
D. Methane

Q.38 **If we know the mass of one substance, we can calculate the volume of other substance and vice versa with the help of chemical equation is called**

A. Mass-mass relationship
[✓ B. Mass-volume relationship]
C. Mass-mole relationship
D. Mole-volume relationship

Q.39 **With the help of spectral data given calculate the mass of Neon and encircle the best option. (Percentage of $^{20}_{10}Ne$, $^{21}_{10}Ne$ and $^{22}_{10}Ne$ are 90.92%, 0.26% and 8.82% respectively)**

A. 22.18 amu
[✓ B. 20.18amu]
C. 21.18amu
D. 22.20amu

Q.40 **How many chlorine atoms are in 2 moles of Cl**

[✓ A. $2 \times 6.022 \times 10^{23}$ atoms]
B. 2×10^{23} atoms
C. $35.5 \times 6.022 \times 10^{23}$ atoms
D. $2 \times 6.02 \times 10^{22}$ atoms

PAST PAPER QUESTIONS

Q.1 If we know the mass of one substance, we can calculate the volume of other substance and vice versa with the help of chemical equation is called MDCAT (2010)
A. Mass-mass relationship [✓ B. Mass-volume relationship]
C. Mass-mole relationship D. Mole-volume relationship

Q.2 One mole of any gas at STP occupies a volume of MDCAT (2010)
[✓ A. $22.414dm^3$] B. $23.414dm^3$
C. $22.414cm^3$ D. $20.414dm^3$

Q.3 How many chlorine atoms are in 2 moles of Cl MDCAT (2011)
[✓ A. $2\times6.022\times10^{23}$ atoms] B. $35.5\times6.022\times10^{23}$ atoms
C. 2×10^{23} atoms D. $2\times6.02\times10^{22}$ atoms

Q.4 An organic compound has empirical formula C_3H_3O if molar mass of the compound is 110.15 molecular formula of this organic compound is MDCAT (2012)
(A, of C = 12, H = 1.008 and O = 16)
[✓ A. $C_6H_6O_2$] B. $C_8H_9O_3$
C. C_2H_2O D. $C_6H_6O_3$

Q.5 When 8 grams (4 moles) of H_2 react with 2 moles of O_2, how many moles of water will be formed MDCAT (2012)
A. Five B. Six
[✓ C. Four] D. Three

Q.6 Hydrogen burns in chlorine to produce hydrogen chloride. The ratio of masses of reactants in chemical reaction $H_2 + Cl_2 \rightarrow 2HCl$ is MDCAT (2013)
A. 2:35.5 [✓ B. 1:35.5]
C. 1:71 D. 2:70

Q.7 A polymer of simplest formula CH_2 has molar mass of 28000 $gmol^{-1}$. Its molecular formula will be MDCAT (2014)
A. 100 times that of its empirical formula B. 500 times of its empirical formula
C. 200 times that of its empirical formula [✓ D. 2000 times that of its empirical formula]

Q.8 The number of molecules in 9g of ice (H_2O) is MDCAT (2014)
A. 6.02×10^{23} B. 6.02×10^{22}
C. 3.01×10^{22} [✓ D. 3.01×10^{23}]

Q.9 How many moles of sodium are present in 0.1g of sodium? MDCAT (2015)
[✓ A. 4.3×10^{-3}] B. 4.01×10^{-2}
C. 4.03×10^{-1} D. 4.3×10^{-2}

Q.10 10.0 grams of glucose are dissolved in water to make 100 cm^3 of its solution, its molarity is MDCAT (2015)
[✓ A. 0.55] B. 10
C. 0.1 D. 1

Q.11 An organic sample consisting of carbon, hydrogen and oxygen was subjected to combustion analysis. 0.5439 g of this compound gave 1.039g carbon dioxide, 0.6369g of water vapors. The empirical formula of this compound is MDCAT (2016)
A. CH_3O [✓ B. C_2H_6O]
C. $C_4H_{12}H_2O$ D. CH_4O

Q.12 The number of moles of CO_2 which contain 8.00g of oxygen is: MDCAT (2016)
A. 0.75 [✓ B. 0.25]
C. 1.50 D. 1.00

Q.13 A researcher has prepared a sample of 1-Bromopropane from 10g of 1-propanol. After purification he had made 12g of product. Which of the following is percentage yield? (The test was reconducteD. MDCAT (2017)
A. 60% B. 90%
[✓ C. 58%] D. 50%

Q.14 **Which one of the followings has same number of molecules as present in 11g of CO_2?** **MDCAT (2017)**

A. 4g of O_2
B. 4g of O
[✓ C. 4.5 g of H_2O]
D. ¼ moles of NaCl

Q.15 **Choose the correct option regarding number of particles associated with one mole of a substance** **MDCAT (2017)**

A. 6.03×10^{23}
B. 6.02×10^{-23}
C. 6.01×10^{-19}
[✓ D. 6.02×10^{23}]

Q.16 **Determinate the number of moles of O in 10.6g of $NaCO_2$** **MDCAT (2017)**

A. 0.4 moles
B. 0.2 moles
[✓ C. 0.3 moles]
D. None of these

"This is actual question given in MDCAT so answer is **0.3 moles**. But if $NaCO_2$ is replaced by Na_2CO_3 Its Answer will be **0.2 moles**."

Q.17 **Calculate the gram of H_2O formed when 8 g of CH_4 burns in excess of oxygen.** **MDCAT (2017)**

A. 21 grams
[✓ B. 18 grams]
C. 19 grams
D. 15 grams

Q.18 **While finding the relative atomic mass, which of the following standard is used to compare the atomic mass of chlorine (35.5amu)** **MDCAT (2018)**

A. Neon-20
B. Nucleon number
C. Carbon-13
[✓ D. Carbon -12]

Q.19 **The formula which shows the simplest whole number ratio for the atoms of different elements in compound** **MDCAT (2018)**

A. Ionic formula
[✓ B. Empirical formula]
C. Structural formula
D. Molecular formula

Q.20 **3.0 mole of calcium will contain _______ g of calcium** **MDCAT (2018)**

A. 105gm
B. 80gm
C. 100gm
[✓ D. 120gm]

Q.21 **The average atomic mass of Boron is 10.8. It has two isotopes of masses 10 and 11 respectively. What is the percentage of isotope with the average mass of 10?** **MDCAT (2019)**

A. 80%
B. 60%
C. 50%
[✓ D. 20%]

Q.22 **Which two elements are isotopes?** **MDCAT (2019)**

A. ${}^{12}_{6}X$ and ${}^{12}_{7}Y$
B. ${}^{16}_{8}X$ and ${}^{16}_{8}Y$
C. ${}^{18}_{9}X$ and ${}^{20}_{10}Y$
[✓ D. ${}^{14}_{8}X$ and ${}^{15}_{8}Y$]

Q.23 **The best standard for the calculation of relative atomic mass** **NUMS (2019)**

A. H-1.008
B. Carbon -12
[✓ C. Carbon-13]
D. Oxygen -16

Q.24 **A piece of diamond embedded in a gold ring weighs 6.0 gram. How many number of moles of Carbon does it contain?** **SET (2019)**

A. 6.0 mole
[✓ B. 0.5 mole]
C. 1.0 mole
D. 1.5 mole

Q.25 **Iron is manufactured industrially in Blast furnace using Hematite, an ore of iron and a reducing agent Carbon monoxide.** $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$ **Calculate the mass of iron ore used to manufacture 56g of iron with excess carbon monoxide. Assume that the process gives 100% yield.** **SET (2019)**

A. 160g
B. 112g
C. 280g
[✓ D. 80g]

Q.26 How many moles of calcium carbonate are present in 1.75 kg of calcium carbonate? (Ar of Ca = 40, Ar of C = 12, Ar of O=16) **MDCAT (2019)**

A. 0.0175 mol
B. 1.75 mol
[✓ C. 17.5 mol]
D. 1750 mol

Q.27 According to law of definite proportion, what is the mass ratio of hydrogen and oxygen in water? **SET (2019)**

[✓ A. Hydrogen is 11.11% and oxygen is 88.89%]
B. Hydrogen is 10.11% and oxygen is 89.89%
C. Hydrogen is 20% and oxygen is 80%
D. Hydrogen is 30% and oxygen is 70%

Q.28 $2XeF_6 + SiO_2 \longrightarrow 3XeOF_4 + SiF_4$ Consider the above chemical reaction. If 122.6g of XeF_6 reacts with 60g of SiO_2 to form the products. Select the limiting reagent and amount of SiF_4 formed (XeF_6 245.3 amu, SiO_2 = 60 amu, SiF_4 = 104 amu) **ETEA (2016)**

[✓ A. XeF_6, 26g]
B. SiO_2, 26g
C. XeF_6, 52g
D. SiO_2, 52g

Q.29 How many oxygen atoms are present in 278g of Hydrated Ferrous Sulphate? ($FeSO_4.7H2O = 278amu$) **ETEA (2016)**

A. 6.023×10^{23}
[✓ B. 6.525×10^{24}]
C. 2.408×10^{23}
D. 6.023×10^{23}

Q.30 The water formed in the combustion analysis is usually absorbed by **ETEA (2016)**

A. $Mg(NO_3)_2$
[✓ B. $Mg(ClO_4)_2$]
C. $Mg(OH)_2$
D. $Mg(ClO_2)_2$

Q.31 Which contains more atoms? **ETEA (2019)**

A. 7gram Mg
[✓ B. 8 gram Na]
C. 9gram Al
D. All same

Q.32 Which contains highest percentage of nitrogen? **ETEA (2019)**

A. NO
B. NO_2
[✓ C. N_2O]
D. N_2O_5

Q.33 A mixture of 10cm of oxygen and 50cm of hydrogen is spared continuously. What is the maximum theoretical decrease in volume? **ETEA (2019)**

A. 10cm^3
B. 15cm^3
C. 20cm^3
[✓ D. 30cm^3]

Q.34 The number of moles of water in 1Kg ice are **MDCAT (2019)**

A. 50 moles
B. 1000 moles
[✓ C. 55.5 moles]
D. 100 moles

Q.35 During stoichiometric calculations, which of the following laws must be followed? **MDCAT (2019)**

[✓ A. Law of conservation of mass]
B. Law of conservation of energy
C. Avogadro's law
D. Dalton's law

Q.36 The efficiency of chemical reaction can be expressed as: **NMDCAT (2020)**

A. Theoretical yield
B. Actual yield
[✓ C. % yield]
D. Maximum yield

Q.37 In a vessel, 10 g N_2 10g H_2 and 10g O_2 are present. Which one will have least number of atoms? **NMDCAT (2020)**

A. H_2
B. N_2
[✓ C. O_2]
D. Both A & B

Q.38 The empirical formula of glucose $C_6H_{12}O_6$ is **NMDCAT (2020)**

A. $C_6H_{12}O_6$
B. CHO
[✓ C. CH_2O]
D. CH_2O_2

ANSWER KEY

1	B	11	B	21	C	31	C
2	C	12	B	22	D	32	B
3	A	13	C	23	A	33	B
4	A	14	B	24	A	34	D
5	D	15	D	25	D	35	C
6	D	16	C	26	D	36	C
7	A	17	D	27	D	37	B
8	A	18	C	28	A	38	B
9	C	19	A	29	A	39	B
10	D	20	B	30	A	40	A

PAST PAPER QUESTIONS

1	B	6	B	11	B	16	C	21	D	26	C	31	B	36	C
2	A	7	D	12	B	17	B	22	D	27	A	32	C	37	C
3	A	8	D	13	C	18	D	23	C	28	A	33	D	38	C
4	A	9	A	14	C	19	B	24	B	29	B	34	C		
5	C	10	A	15	D	20	D	25	D	30	B	35	A		

EXPLANATORY NOTES

Q.1 280 different isotopes occur in nature including 40 radioactive isotopes as well
300 unstable radioactive isotopes produced through artificial disintegration
Among 280 natuarlly occuring isotope, 40 are radioactive isotopes
Out of 280 naturally occuring isotopes, 154 have even mass number and even atomic number

Q.2 There are 2 types of fundamental particles present in the nucleus i.e. proton & neutron.

Q.3 As atomic number of different isotopes of an element is same so they have same electronic configuration hence the will show same chemical properties.

Q.4 ${}^{A}_{Z}X$

'A' is atomic mass and 'Z' is atomic number

Q.5 Molecular ions are formed by passing
High energy electron beam
X-rays
Or *a* particles
Through gases

Q.6 As atomic number of different isotopes of an element is same so they have same electronic configuration hence they will show same chemical properties.

Q.7

$$SiO_2 = 28 + 32 = 60\,g\,mol^{-1}$$

$$n = \frac{m}{M} = \frac{0.6}{60} = 0.01\,moles$$

Q.8 No. Of moles (n) = mass/ M.mass = 4.4 / 44 = 0.1 mole
Volume = n × 22.414 dm^3 = 0.1 × 22.414 = 2.24 dm^3

Q.9 1 mole of any gas occupies 22.4 dm^3 volume at STP

Q.10

$$H_2SO_4 \rightleftharpoons 2H^+ + SO_4^{2}$$

$$0.1 \qquad 2 \times 0.1$$

$$NO.of\ H^+ ions = n \times N_A$$

$$= 0.2 \times 6.02 \times 10^{23}$$

$$= 2 \times 6.02 \times 10^{22}$$

Q.11 No. of electron

$$= n \times N_A$$

$$= 1.0 \times 10^{-16} \times 6.02 \times 10^{23}$$

Q.12

$$Al_2(SO_4)_3 \rightleftharpoons 2Al^{3+} + 3SO_4^{2-}$$

$$1Al_2(SO_4)_3\ produces\ No.of\ particles = 5N_A$$

$$0.5Al_2(SO_4)_3\ produces\ No.of\ particles = 2.5N_A$$

$$= 2.5 \times 6.02 \times 10^{23}$$

$$= 1.5 \times 10^{24}$$

Q.13 Mass of hydrogen = 1 g
Mole of hydrogen = 0.5 mole
No. of electrons in $H_2 = 2 \times n \times N_A = 2 \times 0.5 \times N_A = 1\ N_A\ (6.02\times10^{23})$

Q.14

O_2 : mole of CO_2

32g : 1

$1g : \frac{1}{32}$

$16g : \frac{1}{32} \times 16$

$= 0.5$ mole

Q.15 Molecular mass of a molecule expressed in grams is called gram molecule or mole so 32g is the molar mass of O_2
Mass of one molecule = molar mass of substance / N_A
$= 32 / 6.02\times10^{23}$

Q.16 $\text{Mol of oxygen} = \frac{\text{Given particles}}{\text{Avogadro's number}} = \frac{1.5\times10^{22}}{6.02\times10^{23}} = 0.025\text{mol}$

Mass in grams $= \text{mole} \times \text{molar mass of } O_2$
$= 0.025 \times 32$
$= 0.80g$

Q.17

$1\text{mole Na}^+\text{ion} = 10N_A$ electrons

$1/2\text{moles Na}^+\text{ion} = 5N_A$ electrons

Q.18

$N = n \times N_A$

$= 3\times10^{-21} \times 6.02\times10^{23}$

$= 1800$

Q.19 Relative atomic mass means mass of atom on C–12.0000 scale that is 16 amu for oxygen.
Oxygen gas means molecular oxygen (O_2)

$$\text{Mole} = \frac{\text{Mass}}{\text{M.mass of oxygen gas}}$$

$$2 = \frac{\text{Mass}}{32}$$

$$\text{Mass} = 2\times32 = 64g$$

Q.20

A. Mass of I_2 is 25g

C. g atom means mole of atoms
Mass of O – atoms = Mole × M. mass of O – atoms
$= 25\times16$
$=400g$

B. g mol means mole
mass of H_2O = Mole × M. mass
$= 25\times18 = 450g$

D. mass of N_2 gas is 25g

Q.21 Relative atomic mass of Cl = 35.5 amu
Relative molecular mass of Cl_2 gas = 71 amu
If molecular mass is expressed in g, then it is called mole, so
1mol of Cl_2 gas =71g

Q.22 1mole of any substance contains equal No. of particle i.e. 6.02×10^{23}

Q.23 During combustion analysis, CO_2 is chemically absorbed in 50% KOH
$CO_2 + 2KOH \longrightarrow K_2CO_3 + H_2O$
While H_2O vapour are physically absorbed in Mg $(ClO_4)_2$ because $Mg(ClO_4)_2$ is hygroscopic.

Q.24 During combustion analysis, CO_2 is chemically absorbed in 50% KOH

Q.25 It can be solved theoretically but short cut is to check molecular mass of given options

$$In\ CH_3OH = \frac{16}{32}\times 100$$

$$In\ C_2H_5OH = \frac{16}{46}\times 100$$

$$In\ HCOOH = \frac{32}{46}\times 100$$

$$In\ H_2O = \frac{16}{18}\times 100$$

Q.26 Ionic compounds do not have molecule rather they have formula unit (Empirical formulA. so these don't have molecular formula but have empirical formula

Q.27 In combustion analysis, only those compounds can be analyzed which contain C, H, O and O.
Organic compound + $O_2 \xrightarrow{CuO} CO_2 + H_2O$
(C, H and O containing)
So sole product of combustion analysis are CO_2 and H_2O

Q.28

$$C_3H_4O_4 = 12\times3+1\times4+16\times4$$
$$= 104gmol^{-1}$$

Q.29 To find limiting reactant, its short cut is
(i) Find no. of moles from given amount
(ii) Divide no. of moles by molar coefficient
(iii)Small ratio is considered as liming reactant while large ratio is excess reactant

$$n_{Na} = \frac{230}{23} = 10mol,\ n_{Fe_2O_3} = \frac{320}{160} = 2mol$$

$$6Na \ + \ Fe_2O_3 \longrightarrow 3Na_2O + 2Fe$$

$$\frac{10mol}{6} \qquad \frac{2mol}{1}$$

Limiting reactant ← 1.66 2 → Excess reactant

Q.30 If equal masses of reactants are given then the reactant whose larger mass is used in balance chemical equation is limiting reactant so Mg will be in excess.

Q.31 $C_2H_2 + 5/2O_2 \longrightarrow 2CO_2 + H_2O$
$C_2H_2 : O_2$
1 : 5/2
5 : 5×5/2
= 25/2 = 12.5 cm^3

Q.32 Volume: moles of 'H' atom

22.414 dm^3 contain 4 moles of H-atoms

11.207 dm^3 contain 2 moles of H-atoms

Q.33 $n_{O_2} = \frac{12}{32} = \frac{3}{8}$ mol

$$4Al + 3O_2 \longrightarrow 2Al_2O_3$$

O_2	:	Al
3	:	4
1	:	$\frac{4}{3}$
$\frac{3}{8}$	:	$\frac{4}{3} \times \frac{3}{8}$

$= \frac{1}{2}$

Mass of Al = Mole × Molar mass

$= \frac{1}{2} \times 27$

$= 13.5g$

Q.34 Due to side reaction, reversible reaction and mechanical loss

Q.35 Actual yield is always less than theoretical yield

Q.36 Efficiency of chemical reaction is expressed in term of % age yield

$$\%\text{ age yield} = \frac{\text{Actual / experimental yield}}{\text{Thoretical / calculated yield}} \times 100$$

Actual yield is amount of product formed in chemical reaction while theoretical yield is amount of product obtained in balanced chemical equation.

Q.37

A) $CO + \frac{1}{2}O_2 \longrightarrow CO_2$

B) $C_{(D)} + O_2 \longrightarrow CO_2$

C) $C_2H_6 + \frac{7}{2}O_2 \longrightarrow 2CO_2 + 3H_2O$

D) $CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$

1 mole of ethane give largest mol and mass of CO_2

Q.38 Right statement is called mass volume relationship.

Q.39

$$\textit{Relative atomic mass} = \frac{(20 \times 90.92) + (21 \times 0.26) + (22 \times 8.82)}{100}$$

Q.40 Number of atoms = n × N_A

No. of Cl at0ms $= 2 \times 6.02 \times 10^{23}$

EXPLANATORY NOTES

(PAST PAPER QUESTIONS)

Q.1 When reactants are taken in grams and products in cm^3/dm^3 then it means mass-volume relationship and vice versa.

Q.2 At STP i.e 0°C and 1 atm pressure one mole of any gas occupy volume $22.414 dm^3/22414\ cm^3$.

Q.3 1 mole of Cl-atoms $= 6.02 \times 10^{23}$

Q.4 $$n = \frac{\text{Molecular formula mass}}{\text{Empirical formula mass}} = \frac{110}{55} = 2$$

So molecular formula $= n \times E.F$

$= 2 \times C_3H_3O$

$= C_6H_6O_2$

Q.5 According to balance equation $2H_2 + 1O_2 \rightarrow 2H_2O$

2 mole of water will produce from 2 mole of H_2 and 1 mole of O_2. So, 4 mole of H_2 and 2 mole of O_2 2 will produce 4 mole of water.

$H_2 : H_2O$	$O_2 : H_2O$
2 : 2	1 : 2
4 : 4	2 : 4

Q.6 $H_2 + Cl_2 \rightarrow 2HCl$

2 : 71

1 : 35.5

Q.7 $$n = \frac{\text{Molecular formula mass}}{\text{Empirical formula mass}} = \frac{28000}{14} = 2000$$

So polymer molecular formula is 2000 times to its empirical formula.

Q.8 $$\text{mole "n"} = \frac{\text{mass}}{\text{Molar mass}} = \frac{9}{18} = \frac{1}{2}$$

No. of molecules "N" $= n \times N_A$

$\frac{1}{2} \times 6.02 \times 10^{23}$

$= 3.01 \times 10^{23}$

Q.9 $$\text{mole "n"} = \frac{\text{Mass of element}}{\text{Molar mass of element}} = \frac{0.1}{23} = \frac{1}{23 \times 10} = \frac{100}{100}$$

$$\frac{100}{23 \times 10^3} = 4.3 \times 10^{-3}$$

Q.10 $$\text{Molarity} = \frac{\text{Mass of substance}}{\text{Molar mass of substance}} \times \frac{1000}{\text{V of solution in } Cm^3}$$

$$= \frac{10}{180} \times \frac{1000}{100} = \frac{10}{18} = 0.55M$$

Q.11 EF of any compound can be find out by using 4-step

$$\% \text{ of } C = \frac{\text{Mass of C}}{\text{Mass of organic compound}} \times \frac{12}{44} \times 100$$

$$= \frac{1.039}{0.5439} \times \frac{12}{44} \times 100 = 52.108\% C$$

$$\% \text{ of } H = \frac{\text{Mass of Hydrogen}}{\text{Mass of organic compound}} \times \frac{2.016}{18} \times 100$$

$$= \frac{0.6369}{0.5439} \times \frac{2.016}{18} \times 100 = 13.11\% H$$

$$\% \text{ of } O = 10 - (\% \text{ of } C + \% \text{ of } H)$$

$$= 100 - (58.108 + 13.11) = 34.77\% H$$

No. Of atoms

$$C \Rightarrow \frac{52.108}{12} = 4.34 \quad H \Rightarrow \frac{13.11}{1.008} = 13.01 \quad O = \frac{34.77}{16} = 2.17$$

Atomic Ratio C : H : O

$$\frac{4.34}{2.17} : \frac{13.01}{2.17} : \frac{2.17}{2.17}$$

C : H : O

2 : 6 : 1

C_2H_6O

Q.12 CO_2 1 mole has 12g C and 32g of O_2

So, 32g O_2 is present in = 1 mole of CO_2

1g ------------------------- = 1/32 mole of CO_2

8g ------------------------- = 1/32 × 8 mole of CO_2

= 1/4 = 0.25 mole of CO_2

Q.13 $CH_3CH_2CH_2\text{-}OH \rightarrow CH_3CH_2CH_2\text{-}Br$

1-propanol 1-Bromopropane

Molar Mass = 60 Molar Mass = 123

So 60g 1-propanol will produce =123g 1-Bromopropane

$$1g \text{ ----------------------------------- } = \frac{123}{60}$$

$$10g \text{ given 1-propanol will produce} = \frac{123}{60} \times 10 = 20.5g$$

$$\% \text{ yield} = \frac{\text{Actual yield}}{\text{Theoretical yield}} \times 100$$

$$= \frac{12g}{20.5g} \times 100 = 58.5\%$$

Q.14 11g of CO_2 = 0.25mole of CO_2 or ¼ mole CO_2 molecule

$$a) 4g\ of\ O_2 \rightarrow n = \frac{m}{M} = \frac{4}{32} = \frac{1}{8} mole\ of\ O_2\ molecule$$

$$b) 4g\ of\ O \rightarrow n = \frac{m}{M} = \frac{4}{16} = \frac{1}{4} mole\ of\ O - atom$$

$$c) 4.5g\ of\ H_2O \rightarrow n = \frac{m}{M} = \frac{4.5}{18} = \frac{1}{4} mole\ of\ H_2O\ molecule$$

d) 1/4 mole of NaCl

In B and D option 1/4 mole of O-atom and ¼ mole of formula units of NaCl given, statement is about No. of molecules so C-option is right. Equal no. of moles means equal no. of molecules.

Q.15 1 mole of any substance has no. of particles N_A

Q.16 $$n = \frac{Mass\ of\ substance}{Molar\ mass\ of\ substance} = \frac{10.6g}{106g} = \frac{1}{10} mole$$

In Na_2CO_3, there are 3-oxygen atoms so No. of moles of oxygen atom will be

No. of moles of oxygen atom = mole × atomicity of oxgen $= \frac{1}{10} \times 3 = 0.3$

Q.17 According to balance chemical equation

$1CH_4 + 2O_2 \rightarrow 1CO_2 + 2H_2O$

16g 36g

16g CH_4 on burning in O_2 producing =36g H_2O

1g -- $= \frac{36}{16}$

1g -- $= \frac{36}{16} \times 8 = 18g$

Q.18 Carbon – 12 is used as standard to compare the masses of element / compound because it is stable and its relative atomic amss is 12.0000 amu.

Q.19 Empirical formula shows the simplest whole no. ratio for the atoms of different elements in compound.

Q.20 1 mole fo Ca = 40g

So 3 mole of Ca will be = 40 × 3g = 120g

$m = n \times M$
$m = 3 \times 40$
$= 120g$

Q.21 To calculate relative abundance of an element which has two isotopes we use formula

$$\%of\ Heavier\ isotope = \frac{fractional\ number\ of\ average\ mass}{Difference\ in\ mass\ of\ two\ isotopes} \times 100$$

$$\%of\ B_{11} = \frac{0.8 \times 100}{1} = 80\%$$

If B_{11} is 80% then B_{10} will be 100-80 = 20%

Q.22 Elements having same atomic number and different atomic mass called isotopes

Q.23 Carbon-12 is used as standard to compare the masses of elements / compound because it is stable and its relative atomic mass is 12.0000 amu.

Q.24 $n = \frac{m}{M} = \frac{6}{12} = \frac{1}{2} = 0.5\text{mole}$

Q.25 According to balance chemical equation

$1Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

160g 112g

112g Fe produced from iron are =160g

1g Fe -------------------------------- $= \frac{160}{112}$

56g -------------------------------- $= \frac{160}{112} \times 56 = 80g$

Q.26 Molar mass of $CaCO_3 = 40 + 12 + 48 = 100$

So 1.75kg of $CaCO_3$ = 1750g $CaCO_3$

$$\text{No.of moles} = \frac{\text{Mass of } CaCO_3}{\text{Molar mass of } CaCO_3} = \frac{1750}{100} = 17.5\text{mole}$$

Q.27 Molar mass of H_2O =18

$$\text{Mass ratio / \% of Hydrogen} = \frac{\text{Mass of hydrogen in water}}{\text{Molar mass of water}} \times 100$$

$$= \frac{2}{18} \times 100 = 11.11\%$$

$$\text{Mass ratio / \% of oxygen} = \frac{\text{Mass of oxygen in water}}{\text{Molar mass of water}} \times 100$$

$$= \frac{16}{18} \times 100 = 88.89\%$$

Q.28 For given Rx $2XeF_6 + SiO_2 \rightarrow 3XeOF_4 + SiF_4$

We can find limiting reactant in two step.

Step (1) Find mole

Mole of XeF_6

$n = \frac{m}{M} = \frac{122.5}{245} = \frac{1}{2} = 0.5$

Mole of SiO_2

$n = \frac{m}{M} = \frac{60}{60} = 1$

Step (2) Divide no. of mole with coefficient (no used in balance chemical equation)

For XeF_6

$\frac{\text{Mole}}{\text{Co-efficient}} = \frac{0.50}{2} = 0.25$

For SiO_2

$\frac{\text{Mole}}{\text{Co-efficient}} = \frac{1}{1} = 1$

In 2nd step smallaer value is limiting reactant so

XeF_6 is limiting reactant

So, 2 mole of XeF_6 (490g) and 1 mole SiF_4 (104g)

490g of XeF_6 producing = 104g SiF_4

1g of XeF6 will produce $= \frac{104}{490}$

122.5g ------------------------ $= \frac{104}{490} \times 122.5 = 26g$

Q.29 $\text{No. of moles} = \frac{\text{Mass of substance}}{\text{Molar mass of substance}} = \frac{278}{278} = 1\,\text{mole}$

No. of oxygen atoms in $FeSO_4\,7H_2O = 11$

So no. of oxygen atoms = mole × N_A × Atomicity of oxygen

$= 1 \times 6.02 \times 10^{23} \times 11$

$= 6.62 \times 10^{24}$ atoms.

Q.30 During combustion analysis water absorbed by $Mg(ClO_4)_2$

Q.31

$$a)\, n = \frac{m}{M} = \frac{7}{24} = 0.291 \Rightarrow N = n \times N_A \Rightarrow 0.291 \times N_A$$

$$b)\, n = \frac{m}{M} = \frac{8}{23} = 0.347 \Rightarrow N = n \times N_A \Rightarrow 0.347 \times N_A$$

$$c)\, n = \frac{m}{M} = \frac{9}{27} = 0.333 \Rightarrow N = n \times N_A \Rightarrow 0.333 \times N_A$$

8g Na has highest no. of moles so it will contain more atoms than others.

Q.32

$$\%\text{of Nitrogen} = \frac{\text{Mass of Nitrogen}}{\text{Molar mass of compound}} \times 100$$

$$a)\,\%\text{of Nitrogen} = \frac{14}{30} = \frac{14}{30} \times 100$$

$$b)\,\%\text{of Nitrogen} = \frac{14}{46} = \frac{14}{46} \times 100$$

$$c)\,\%\text{of Nitrogen} = \frac{28}{44} = \frac{14}{22} \times 100$$

$$d)\,\%\text{of Nitrogen} = \frac{28}{108} = \frac{14}{54} \times 100$$

Denominator of C option (N_2O) is smallest so it will have highest % of nitrogen.

Q.33 $2H_2 + 1O_2 \rightarrow 2H_2O$

H_2 : O_2

2 : 1

According to balance chemical equation $1cm^3$ O_2 will use 2 cm^3 H_2 so 10 cm^3 will use 20 cm^3 H_2.

So total volume consumed = $30cm^3$

Q.34 1 Kg ice = 1000g ice

$$\text{mole "n"} = \frac{\text{mass of ice}}{\text{Molar mass of ice}} = \frac{1000}{18} = 55.5\,\text{moles}$$

Q.35 Two laws should be obeyed i.e. law of conservation of mass and law of definite proportion.

Q.36 Efficiency of chemical reaction expressed by % yield

$$\% \text{ yield} = \frac{\text{Actual yield}}{\text{Theoretical yield}} \times 100$$

Q.37 Least no. of moles carrying substance will have least No. of atoms

a) $10g\,N_2 \quad n = \frac{m}{M} = \frac{10}{28}$

b) $10g\,H_2 \quad n = \frac{m}{M} = \frac{10}{2}$

c) $10g\,O_2 \quad n = \frac{m}{M} = \frac{10}{32}$

In case of oxygen denominator is larger than other. So, it will have least no. of moles and atoms.

Q.38 Empirical formula of $C_6H_{12}O_6$ is CH_2O

Topic 2 ATOMIC STRUCTURE

PRACTICE EXERCISE

Q.1 The mass of proton is
A. 9.1095×10^{-31} kg
B. 1.602×10^{-19} kg
[✓ C. 1.6726×10^{-27} kg]
D. 1.6750×10^{-27} kg

Q.2 What will be the effect on proton when passed through the electric field
A. Deflection towards anode
B. Deflection perpendicular to electric field
[✓ C. Deflection towards cathode]
D. Deflection downwards in electric field

Q.3 Positive rays are produced
A. By burning of gas
B. By cooling of the gas
[✓ C. By the bombardment of cathode rays on gas molecules]
D. From anode like cathode rays, produced from cathode

Q.4 Pressure in gas discharge tube was kept
A. 10 torr
B. 1 torr
C. 0.1 torr
[✓ D. 0.01 torr]

Q.5 Positive rays give flash on
A. $AgNO_3$ plate
B. AgCl plate
C. ZnO
[✓ D. ZnS]

Q.6 The relationship between energy of a photon of light and its frequency is given by
A. de-Broglie dual nature of matter
B. Bohr's model
[✓ C. Planck's Quantum theory]
D. Rutherford's atomic model

Q.7 The velocity of the photon
[✓ A. Is independent of wavelength]
B. Depends upon source
C. Depends upon its frequency
D. Equals to the square of amplitude

Q.8 Plank's theory says energy is emitted
A. In continuous manner
[✓ B. In discontinuous manner]
C. Simultaneously
D. In the form of heat

Q.9 Planck's equation is
A. $E = mc^2$
B. $mvr = nh/2\pi$
[✓ C. $E = h\upsilon$]
D. $\lambda = h/mv$

Q.10 Quantum number which is not derived from Schrodinger wave equation
A. Principal
B. Azimuthal
C. Magnetic
[✓ D. Spin]

Q.11 A nodal plane in an orbital is the plane where electron density is
A. Maximum
[✓ B. Zero]
C. Infinity
D. Minimum

Q.12 The number of degenerate orbitals in a sub-shell having sausage shape are
A. 1
C. 3
B. 5
D. 7 B

Q.13 Quantum number values for 3p orbital are
A. $n = 3, l = 0$
[✓ B. $n = 3, l = 1$]
C. $n = 2, l = 1$
D. $n = 2, l = 3$

Q.14 **Maximum number of electrons that can be accommodated in p-subshell**
A. 2
[✓ B. 6]
C. 10
D. 14

Q.15 **Which sub-shell has highest energy**
[✓ A. n=5, ℓ=3, m=+1]
B. n=5, ℓ=2, m=+2
C. n=4, ℓ=3, m=0
D. n=4, ℓ=0, m=+1

Q.16 **Magnetic quantum number values for the d subshell are**
A. 2
B. 3
[✓ C. 5]
D. 7

Q.17 **A p-orbital has ______ energy than the s-orbital of same principal quantum number**
A. Lower
[✓ B. Higher]
C. Equal
D. Variable orbit to orbit

Q.18 **Which set of quantum number represents 19th electron of Cu atom**
[✓ A. $n=4,\quad \ell=0,\quad m=0,\quad s=+\frac{1}{2}$]
B. $n=3,\quad \ell=2,\quad m=0,\quad s=+\frac{1}{2}$
C. $n=4,\quad \ell=1,\quad m=0,\quad s=+\frac{1}{2}$
D. $n=3,\quad \ell=0,\quad m=0,\quad s=+\frac{1}{2}$

Q.19 **The d-orbital which is bi-lobed with collar is represented as**
A. dxy
B. dyz
[✓ C. dz^2]
D. dx^2-y^2

Q.20 **________ is/are isoelectronic with K^+**
A. P^{-3}
B. Si^{-4}
C. S^{-2}
[✓ D. All of these]

Q.21 **The atomic number of an element is 26. How many electrons are present in M-Shell of this element in ground state**
A. 11
[✓ B. 14]
C. 15
D. 16

Q.22 **The electronic configuration of an element is $1s^2, 2s^2, 2p_x^1, 2p_y^1, 2p_z^1$. This represents a/an**
[✓ A. Ground state]
B. Excited state
C. Hybridized state
D. Molecular state

Q.23 **The correct electronic configuration of $_{29}Cu$ is**
A. $[Ar]4s^2 3d_{xy}^2 3d_{yz}^2 3d_{xz}^2 3d_{x^2-y^2}^2 3d_{z^2}^1$
[✓ B. $[Ar]4s^1 3d_{xy}^2 3d_{yz}^2 3d_{xz}^2 3d_{x^2-y^2}^2 3d_{z^2}^2$]
C. $[Ar]4s^1 3d_{xy}^2 3d_{yz}^2 3d_{xz}^2 3d_{x^2-y^2}^2 3d_{z^2}^1$
D. $[Ar]4s^1 3d_{xy}^2 3d_{yz}^2 3d_{xz}^2 3d_{x^2-y^2}^1 3d_{z^2}^1$

Q.24 **Which one of the following ion has similar electronic configuration like Ar**
A. Sc^{+2}
[✓ B. Ti^{+4}]
C. Cr^{+2}
D. Mn^{+6}

Q.25 **In electronic configuration of Cu and Cr which of following is true**
A. 3-d is full filled
B. 3-d is half filled
[✓ C. 7 electrons in s-orbitals]
D. 8 electrons in s-orbitals

Q.26 **Which of the following violates Hund's rule?**
A. $1s^2, 2s^2, 2p_x^1, 2p_y^1, 2p_z^1$
B. $1s^2, 2s^2, 2p_x^2, 2p_y^2, 2p_z^1$
C. $1s^2, 2s^1$
[✓ D. $1s^2, 2s^2, 2p_x^2, 2p_y^0, 2p_z^0$]

Q.27 Which one of the following represents most stable configuration of three electrons for ground state of an element in group VA

A. np_x^2, np_y^1, np_z^0

[✓ B.] np_x^1, np_y^1, np_z^1

C. np_x^2, np_y^0, np_z^1

D. np_x^0, np_y^1, np_z^2

Q.28 Which one of following electronic configuration represents an element that form a simple ion with -3 charge

A. $1s^2, 2s^2, 2p^6, 3s^2, 3p^1$

[✓ B.] $1s^2, 2s^2, 2p^6, 3s^2, 3p^3$

C. $1s^2, 2s^2, 2p^6, 3s^1$

D. $1s^2, 2s^2, 2p^1$

Q.29 A specie Z has following electronic configuration $1s^2, 2s^2, 2p_x^2, 2p_y^2, 2p_y^2, 3s^2, 3p_x^2, 3p_y^1, 3p_z^1$ What could Z be

A. Ar

B. Cl^-

[✓ C.] S

D. P^{3-}

Q.30 The total number of lobes in all the orbitals of a d-subshell are

A. 2

B. 16

C. 4

[✓ D.] 18

Q.31 "Two electrons in the same orbital should have opposite spins" according to

A. Aufbau's principal

[✓ B.] Pauli's exclusion rule

α [✓ C.] Hund's rule

D. None of these

Q.32 Which of following configuration is not correct according to Hund's rule

α [✓ A.] [↑↓] [↑|↑|↑]

B. [↑↓] [↑|↑|]

✓ [✓ C.] [↑↓] [↑|↓|↑]

D. [↑↓] [↑↓|↑↓|↑]

Q.33 The e/m value for the canal rays is maximum for

[✓ A.] Hydrogen

B. Nitrogen

C. Helium

D. Argon

Q.34 Correct order of energy in the given sub-shells is:

A. 5s > 3d > 3p > 4s

B. 3p > 3d > 5s > 4s

[✓ C.] 5s > 3d > 4s > 3p

D. 3p > 3d > 4s > 5s

Q.35 Maximum numbers of electron in a sub-shell is given by

A. $2(2l-1)$

[✓ B.] $2(2l+1)$

C. $2(l+1)$

D. $2l+1$

PAST PAPER QUESTIONS

Q.1 Which quantum number tells us about orientation of orbitals: MDCAT (2010)

A. Principal quantum number
B. Spin quantum number
C. Azimuthalquantum number
[✓ D. Magnetic quantum number]

Q.2 The relative energies of 4s, 4p and 3d orbitals are in the order MDCAT (2012)

A. $3d < 4p < 4s$
B. $4p < 4s < 3d$
[✓ C. $4s < 3d < 4p$]
D. $4p < 3d < 4s$

Q.3 With increase in the value of principal quantum number 'n', the shape of the s-orbitals remain same although their sizes MDCAT (2012)

A. Decrease
B. Remain the same
[✓ C. Increase]
D. May or may not remain the same

Q.4 Number of electrons in the outermost shell of chloride ion(Cl^-) is: MDCAT (2013)

A. 17
B. 1
C. 7
[✓ D. 8]

Q.5 Correct order of energy in the given sub-shells is: MDCAT (2013)

A. $5s > 3d > 3p > 4s$
B. $3p > 3d > 5s > 4s$
[✓ C. $5s > 3d > 4s > 3p$]
D. $3p > 3d > 4s > 5s$

Q.6 According to the number of protons, neutrons and electrons given in the table, which one of the following option is correct? MDCAT (2014)

Species	Proton	Neutron	Electron
As	33	42	30
Ga	31	39	28
Ca	20	20	20

[✓ A. As^{+3}, Ga^{+3}, Ca]
B. $As^{+3}, Ga^{+3}, Ca^{+2}$
C. As^{+3}, Ga^{+2}, Ca
D. As^{+3}, Ga, Ca^{+2}

Q.7 There are four orbitals s, p, d and f. Which order is correct with respect to the increasing energy of the orbitals MDCAT (2015)

[✓ A. $4s < 4p < 4d < 4f$]
B. $4s < 4f < 4p < 4d$
C. $4p < 4s < 4f < 4d$
D. $4f < 4s < 4d < 4p$

Q.8 Which one of the following pairs has the same electronic configuration as possessed by neon (Ne-10) MDCAT (2015)

A. Na^+, Cl^-
B. Na^+, Mg^+
C. K^+, Cl^-
[✓ D. Na^+, F^-]

Q.9 Number of neutrons in $^{66}_{30}Zn$ will be: MDCAT (2016)

A. 30
B. 38
C. 35
[✓ D. 36]

Q.10 The maximum number of electrons in electronic configuration can be calculated by using formula: MDCAT (2016)

A. $2l+1$
[✓ B. $2n^2$]
C. $2n^2+2$
D. $2n^2+1$

Q.11 Number of electrons in $^{71}_{31}Ga^{3+}$ Will be MDCAT (2017)

[✓ A. 28]
B. 30
C. 29
D. 34

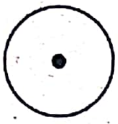
Q.12 Isotopic symbol of ion of Sulphur–33 is $^{33}_{16}S^{-2}$ How many number of protons and neutrons are present if number electrons are 18? **MDCAT (2017)**

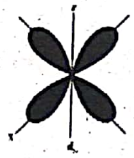
A. P = 18, n = 15
B. P = 16, n = 18
[✓ C]. P = 16, n = 17
D. P = 17, n = 16

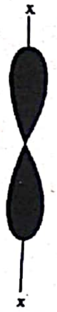
Q.13 Among the following, which contains same no. of electrons & proton but different no. of neutron: **MDCAT (2017)**

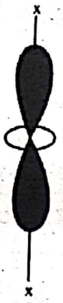
A. Isobars
B. Isotones
[✓ C] Isotopes
D. None of the these

Q.14 Identify the correct option associated with the shape of p-orbital: **MDCAT (2017)**

A.


B.


[✓ C]


D.


Q.15 Which is the correct electronic configuration of chromium ($_{24}Cr$)? **MDCAT (2018)**

A. $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^4$
[✓ B]. $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1, 3d^5$
C. $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^6$
D. $1s^2, 2s^2, 3s^2, 3p^6, 3p^6, 4s^2, 3d^6$

Q.16 Maximum numbers of electron in a sub-shell is given by **NUMS (2019)**

A. $2(2l-1)$
[✓ B]. $2(2l+1)$
C. $2(l+1)$
D. $2l+1$

Q.17 The order of energy level in ^{19}K is? **NUMS (2019)**

A. 4s, 4p
B. 4s, 3d
[✓ C]. 3p, 4s
D. 3s, 3d

Q.18 Which of the following element in its atomic state has electrons fully occupying first two spherically symmetrical orbitals? **SET (2019)**

A. Oxygen
B. Helium
[✓ C] Beryllium
D. Carbon

Q.19 What are the values of principal quantum number and azimuthal quantum number for the last electron in Chlorine atom? **ETEA (2016)**

A. 1, 6
B. 1, 3
[✓ C]. 3, 1
D. 6, 1

Q.20 Which of the following electronic configuration is / are correct? **ETEA (2016)**

(i) $^{29}Cu\ 1s^2 2s^2 3p^6, 3s^1$
(ii) $^{29}Cu[Ar]4s^1 3d^{10}$
(iii) $^{24}Cr[Ar]4S^1 3d^{10}$
(iv) $^{24}Cr[Ar]4S^2 3d^4$

A. 1 only
[✓ B]. II only
C. 1 and II only
D. II and III only

Q.21 **Quantum number which describes the orientation of orbitals in three dimensional space is** ETEA (2019)

A. Spin quantum number B. Azimuthal quantum number

[✓ C. Magnetic quantum number] D. Principal quantum number

Q.22 **Which of the following is the electronic configuration of Cr?** MDCAT (2019)

A. $[Ar]3d^5 4s^2$ B. $[Ar]3d^4 4s^2$

C. $[Ar]3d^6 4s^0$ [✓ D. $[Ar]3d^5 4s^1$]

Q.23 **The relationship between quantum number n and ℓ is:** NMDCAT (2020)

A. n = l-1 B. ℓ=n-2

[✓ C. ℓ = n-1] D. n=ℓ-2

Q.24 **Quantum number values for '2P' orbitals are** NMDCAT (2020)

[✓ A. n=2 l=1] B. n=1 l=2

C.n=1 l=0 D. n=2 l=0

Q.25 **Which pair has 1 electron in its orbital?** NMDCAT (2020)

A. Li& Fe [✓ B. Na & Cr]

C.K & Mn D. H & He

Q.26 **Which of the following has the lowest e/m ratio?** NMDCAT (2020)

A. Li^{2+} B. H^{+1}

C. He^{+} [✓ D. Be]

ANSWER KEY

1	C	11	B	21	B	31	B
2	C	12	B	22	A	32	C
3	C	13	B	23	B	33	A
4	D	14	B	24	B	34	C
5	D	15	A	25	C	35	B
6	C	16	C	26	D		
7	A	17	B	27	B		
8	B	18	A	28	B		
9	C	19	C	29	C		
10	D	20	D	30	D		

PAST PAPER QUESTIONS

1	D	6	A	11	A	16	B	21	C	26	D
2	C	7	A	12	C	17	C	22	D		
3	C	8	D	13	C	18	C	23	C		
4	D	9	D	14	C	19	C	24	A		
5	C	10	B	15	B	20	B	25	B		

EXPLANATORY NOTES

Q.1 Mass of protons is 1.6726×10^{-27} kg

Q.2 Protons are positively charged particles which show deflection towards cathode in electric field

Q.3 Positive rays are produced by bombardment of cathode rays on gas moleculesin dischage tube

Q.4 At low pressure (0.01 torr) ther is large spaces between gas molecules and there will be less hinderance for cathode rays to travel from cathode to anode.

Q.5 Positive rays produce flashes upon ZnS plate

Q.6 According to Planck's quantum theory, $E \alpha \nu$ or $E = h\nu$

Q.7 Velocity of photon is independent of wavelength

$c = \nu \times \lambda$

Product of frequency and wavelength remains constant quantity because of inverse relationship between frequency and wavelength.

Q.8 According to Planck's quantum theory, there is no continuous emission or absorption of energy.

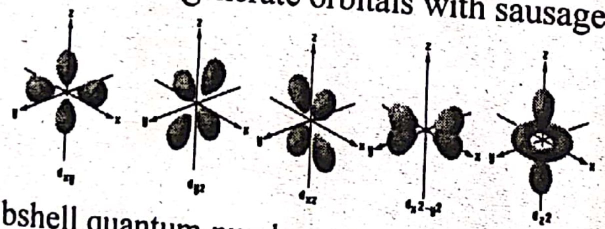
Q.9 Different forms of Planck's theory are,

$E = h\nu$ or $E = hc\bar{\nu}$ or $E = hc/\lambda$

Q.10 Quantum number which is not derived from Schrodinger wave equation is spin quantum number it was given by Uhlenbeck and Goudsmith

Q.11 Nodal plane is the area where the probability of finding of electron is zero

Q.12 d-subshell has five degenerate orbitals with sausage shape



Q.13 For 3p subshell quantum number values are $n = 3$, $\ell = 1$

Azimuthal Q. number	Sub-shell	Shapes
$\ell = 0$	s-subshell	Spherical
$\ell = 1$	p-subshell	dumbell
$\ell = 2$	d-subshell	double dumbell or sausage shape
$\ell = 3$	f-subshell	complicated

Q.14 Number of electrons in a subshell = $2(2\ell + 1)$

Sub-shell	Electrons
s = 0	2
p = 1	6
d = 2	10
f = 3	14

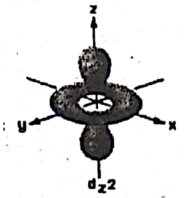
Q.15 Energy of subshell α (n+ℓ) $1s < 2s < 2p < 3s < 3p < 4s < 3d < 4p < 5s < 4d < 5p < 6s < 4f$

Q.16 For d-subshell, ℓ=2 so,
d_{xy}(m =-2), d_{yz}(m =-1), d_{zx}(m =+1), $d_{x^2-y^2}$ (m= +2) and d_{z^2} (m=0).

Q.17 Energy of subshell α (n+ℓ), Energy order . $s < p < d < f$

Q.18 Cooper 29 $[Ar]4s^1 3d^2_{xy} 3d^2_{yz} 3d^2_{xz} 3d^2_{x^2-y^2} 3d^2_{z^2}$ so set of quantum number values is
$n = 4,\ \ell = 0,\ m = 0,\ s = +1/2$

Q.19 dz^2 orbital is bi-lobed with collar



Q.20 ${}_{19}K^{+1}$ → 18 electrons, ${}_{15}P^{-3}$ → 18 electrons, ${}_{16}S^{-2}$ → 18 electrons, ${}_{14}Si^{-4}$ → 18 electrons

Q.21 M shell = 3rd shell, by given configuration, 3s → $2e^{-1}$, 3p → $6e^{-1}$, 3d → $6e^{-1}$
${}_{26}Fe = 1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^6$
So number of electrons in M shell are 14.

Q.22 This configuration represents ground state electronic configuration of nitrogen atom

Q.23 Electronic configuration of ${}_{29}Cu = [Ar], 4s^1, 3d^{10}$

Q.24 Argon → 18 electrons, T_i^{+4} → (22-4)18 electrons, so both are iso-electronic

Q.25 ${}_{24}Cr = 1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1, 3d^5$
${}_{29}Cu = 1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1, 3d^{10}$
Both have seven electrons in s-subshll

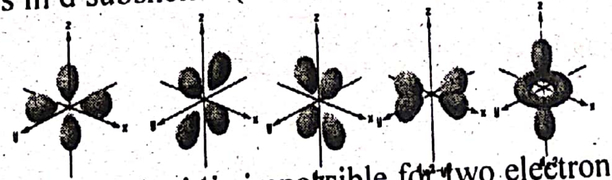
Q.26 In degenerate orbitals, electrons go one by one with same spin rather than to go same orbital with opposite spin

Q.27 Half-filled and completely filled orbitals are relatively more stable.

Q.28 ${}_{15}P = 1s^2, 2s^2, 2p^6, 3s^2, 3p^3$, Phosphorous has 5-electrons in valance shell. To complete its octet it needed 3 electrons

Q.29 In neutral atom, atomic number is the number of electrons, "Z" has 16 electrons, so atomic number is 16 that is for sulphur. ${}_{16}S = {}_{10}[Ne]3s^2 3p_x^2 3p_y^1 3p_z^1$

Q.30 Each d-orbital has four lobes except dz^2 which has two lobes with collar, so
Number of lobes in d subshell = (4 × 4) + 2 = 18



Q.31 According to this principle, it is impossible for two electrons residing in the same orbital of poly-electron atom to have same values of four quantum numbers.

Q.32 If more than one degenerate orbitals are available then electrons go one by one with same spin

Q.33 The value of e/m of positive rays is inversely proportional to molar mass of gas, Hydrogen has least mass so has highest e/m value

Q.34 Energy of subshell is directly proportional to (n+ℓ) value, if (n+ℓ) value for 2 orbitals is same then energy depends upon "n" value. Greater the value of "n" greater the energy

Q.35 No. of orbitals in a subshell = $(2\ell+1)$
No. of electrons in a subshell = $2(2\ell+1)$

EXPLANATORY NOTES

(PAST PAPER QUESTIONS)

Q.1 Magnetic quantum number explains orientation and degeneracy of orbitals. So it is called as orientation quantum number.

Q.2 Relative energies of different orbitals can be find out by using $(n+\ell)$ rule. $(4s = 4 + 0 = 4)$, $(4p = 4 + 1 = 5)$, $(3d = 3 + 2 = 5)$. When $(n+\ell)$ value are same for 2 different subshells then subshell with larger "n" value has high energy.

Q.3 With increase in the value of principal Q.N. "n", the size and energy of orbitals increases.

Q.4 Cl atom has 7 electrons in valance shell and Cl^{-1} has 8 electrons in the valance shell.

Q.5 By using $(n+\ell)$ rule $(5s = 5 + 0 = 5)$, $(3d = 3 + 2 = 5)$, $(3p = 3 + 1 = 4)$ and $(4s = 4 + 0 = 4)$ so the correct order is $5s > 3d > 4s > 3p$.

Q.6 In neutral atom, No. of electrons are always equal to No. of protons.

- If As has 33 protons and 30 electrons then it means As loses 3 electrons, so it will carry +3 charge (As^{+3})
- If Ga has 31 protons and 28 electrons then it means Ga loses 3 electrons, so it will carry +3 charge (Ga^{+3})
- If Ca has 20 protons and 20 electrons then it means Ca does lose any electrons, so it will carry no net charge (Ca^{0})

Q.7 By using $(n+\ell)$ rule $(4s = 4 + 0 = 4)$, $(4p = 4 + 1 = 5)$, $(4d = 4 + 2 = 6)$ and $(4f = 4 + 3 = 7)$ so the correct order is $4s < 4p < 4d < 4f$.

Q.8 According to electronic configuration, we noticed that following configuration are similar to the configuration of Neon.

$Na = 1s^2, 2s^2, 2p^6, 3s^1$ and $Na^{+1} = 1s^2, 2s^2, 2p^6, 3s^0$

$F = 1s^2, 2s^2, 2p^5$ and $F^{-1} = 1s^2, 2s^2, 2p^6$

$Ne = 1s^2, 2s^2, 2p^6$

Q.9 No. of neutrons can be find out by using formula

$N = A - Z = 66 - 30 = 36$

Q.10 Maximum No. of electrons in a shell van be find out by using $2n^2$ formula. For example, if $n = 3$ then $2(3)^2 = 18$ electrons.

Q.11 Atomic number of Ga has 31 electrons, it means Ga has 31 protons and 31 electrons but in +3 oxidation state it loses 3 electrons, so Ga^{+3} has 28 electrons.

Q.12 $^{33}_{16}S^{-2}$ has 18 electrons. Atomic No. of Sulphur is 16, so it has 16 protons.

No. of neutrons $= A - Z = 33 - 16 = 17$ N.

Q.13 Isotopes having same atomic No. and different atomic mass

Isobar having same atomic mass and different atomic No.

Isotones having same number of nuetron.

Q.14 p-orbital has dumb-bell shape.

Q.15 ${}_{24}Cr = 1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1, 3d^5$

Q.16 No. of electrons in a subshell $= 2(2\ell + 1)$.

Q.17 ${}_{19}K = 1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1$

Q.18 Spherically symmetrical orbitals means s-subshell. So, ${}_{4}Be = 1s^2, 2s^2$.

Q.19 ${}_{17}Cl = 1s^2, 2s^2, 2p^6, 3s^2, 3p^5$, last electron of Cl atom present in 3p, so value of principal quantum number is 1.

Q.20 ${}_{24}Cr = 1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1, 3d^5$ and ${}_{29}Cu = 1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1, 3d^{10}$ in given options, ${}_{29}Cu$ is correct one.

Q.21 Magnetic quantum number, explain the orientation of orbitals in three dimensional space.

Q.22 ${}_{24}Cr = 1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1, 3d^5$, ${}_{24}Cr$ [Ar], $4s^1, 3d^5$

Q.23 Azimuthal quantum no. $\ell = n-1$

If $n = 1, 2, 3, 4, \ldots.$ Then $\ell = 0, 1, 2, 3, \ldots.$

Q.24 Quantum No. values for 2p-orbitals are $n = 2, \ell = 1$

Q.25 $Na = 1s^2, 2s^2, 2p^6, 3s^1$ and ${}_{24}Cr = 1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1, 3d^5$.

Q.26 Greater the mass, lesser the e/m value charge is directly proportional to e/m value and mass inversely proportional to e/m value.

Topic 3 GASES

PRACTICE EXERCISE

Q.1 **At constant temperature when the pressure of gas is increased three times then its volume becomes**

A. $\frac{2V}{3}$ B. 3V

[✓ C]. $\frac{V}{3}$ D. 5V

Q.2 **Under what conditions the density of an ideal gas will be maximum at**

A. High temperature and low pressure

[✓ B]. Low temperature and high pressure

C. Low temperature and pressure

D. When temperature and pressure are same

Q.3 **If $\frac{1}{V}$ is plotted on X-axis and pressure on Y-axis at constant temperature, what should appear**

A. Straight line parallel to x-axis B. Straight line parallel to y-axis

[✓ C]. Straight line passing through origin D. Curve

Q.4 **The general gas equation to know the volumes of the gas at various temperatures is**

A. $V_o = \frac{273V_T}{273+t}$ B. $V_o = V_T\left(1-\frac{t}{273}\right)$

[✓ C]. $V_t = V_0\left(1+\frac{t}{273}\right)$ D. None of the above

Q.5 **A mono-atomic substance can store energy only in the form of**

[✓ A]. Translational motion B. Rotational motion

C. Vibrational motion D. Rotational and vibrational motion

Q.6 **A graph between pressure and product of pressure and volume at constant temperature and number of moles is**

[✓ A]. Straight line parallel to x-axis

B. Straight line parallel to y-axis

C. Straight line passing through the origin

D. The curve showing the maximum

Q.7 **If both temperature and volume of a gas are doubled, the pressure**

A. Cannot be predicated [✓ B]. Remain unchanged

C. Is reduced to ½ D. Is doubled

Q.8 **Which one is the form of general gas equation?**

A. PV = nRT B. PV = RT

C. $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ [✓ D]. All of these

Q.9 **Volume of a gas at STP is 10 dm³ at what temperature its volume will become 30dm³, keeping pressure constant**

A. 3°C B. 819°C

[✓ C]. 819K D. 3K

Q.10 **Which of the following pairs of gases possess equal volume at STP**
A. 44g CO_2 and 44g CO
B. 16g O_2 and 32gCH_4
C. 3.01×10^{23} molecules of CO and 3.01×10^{23} gram molecules of H_2
[✓ D. 0.5 mole of NO and 16 g O_2]

Q.11 **Which is incorrect about ideal gas**
A. No force of attraction between molecules
B. No example in nature
[✓ C. Can be liquefied easily]
D. Obey gas laws at all conditions of temperature and pressure

Q.12 **A gas initially at 27°C is heated upto 327°C, its average K.E will be**
[✓ A. Doubled]
B. Four times
C. 300 times
D. 327 times

Q.13 **The correct value of general gas constant R is**
A. 8.314 atm dm^3 $mol^{-}K^{-}1$
B. 0.0821 $Jmol^{-1}K^{-1}$
C. 62.4 torr cm^3 $mol^{-1}K^{-1}$
[✓ D. 8.314×10^7 erg $mol^{-1}K^{-1}$]

Q.14 **In gases and liquids, temperature is the measure of ______ kinetic energies of molecules**
[✓ A. Average translational]
B. Rotational
C. Vibrational
D. All of these

Q.15 **The molar volume of nitrogen gas is maximum at**
A. 25°C and 1 atm
B. 0°C and 2 atm
[✓ C. 130°C and 1 atm]
D. 100°C and 2 atm

Q.16 **8g of methane and 2g of hydrogen are mixed and kept at 760 mm pressure at 273 K, the total volume occupied by the mixture will be**
A. 11.2 dm^3
B. 22.4 dm^3
[✓ C. 33.6 dm^3]
D. 44.8 dm^3

Q.17 **What is NOT true about gases**
A. They are highly compressible
[✓ B. They have only vibrational motion]
C. Sudden expansion of gases cause cooling
D. They exert pressure on the walls of the vessel

Q.18 **For a definite mass of an ideal gas at constant temperature, the plot of which pair of species will give a curved graph**
A. PV vs P
[✓ B. P vs V]
C. P vs V^{-1}
D. PV vs P^{-1}

Q.19 **A pressure of 0.101325 bar when expressed in atmosphere represents**
A. 0.01 atm
B. 1.0 atm
[✓ C. 0.1 atm]
D. 10.0 atm

Q.20 **Dimensions of the pressure are the same as that of**
A. Energy
B. Force
[✓ C. Energy per unit volume]
D. Force per unit volume

Q.21 **Gases deviate from ideal behavior at high pressure. Which of the following is correct for non-ideality?**
A. At high pressure, the gas molecules move in one direction only
B. At high pressure, the collision between the gas molecules are increased manifold
C. At high pressure, the volume of the gas becomes insignificant
[✓ D. At high pressure, the inter-molecular attractions become significant]

Q.22 Under high pressure which of the following gas show more ideality in character

[✓ A. N_2]
B. CO_2
C. NH_3
D. SO_2

Q.23 When 200cm³ of a gas at constant pressure is heated, its volume

[✓ A. Increases]
B. Remains unchanged
C. Decreases
D. First increases then decreases

Q.24 The product of PV of a gas has unit of

A. Force
B. Entropy
[✓ C. Work]
D. Enthalpy

Q.25 Under what condition of temperature and pressure will a real gas behave most like an ideal gas?

A. Low temperature and low pressure
B. Standard temperature and standard pressure
C. Low temperature and high pressure
[✓ D. High temperature and low pressure]

Q.26 Absolute temperature of a gas is directly proportional to average ______

A. Rotational K.E
[✓ B. Translational K.E]
C. Vibrational K.E
D. None of these

Q.27 An ideal gas can't be liquefied because

A. Its critical temperature is always above 0°C
B. Its molecules are smaller in size
C. It solidifies before becoming a liquid
[✓ D. Forces between its molecules are negligible]

Q.28 The compressibility factor, Z, for an ideal gas is

A. Zero
B. Less than one
C. Greater than one
[✓ D. Equal to one]

Q.29 In $dm^3\ atm\ K^{-1}mol^{-1}$ the numerical value of general gas constant R is

A. 1.989
B. 8.314
[✓ C. 0.0821]
D. 62400

Q.30 In a closed flask of one dm³, 2.0g of hydrogen gas is heated from 27°C to 327°C. Which of the following is incorrect

A. The pressure of the gas increases
B. The kinetic energy of gas molecules increases
C. The rate of collision increases
[✓ D. The number of moles of the gas increases]

Q.31 A pressure of a gas is due to

A. Rapid intermolecular collisions
[✓ B. Molecular impacts against the walls of vessel]
C. Voids between the gas molecules
D. Ideal behaviour of gases

Q.32 **The compressibility factor, Z i.e. the extent to which a real gas deviates from ideal behaviour is given by (for one mole)**

A. $Z = \frac{PV}{RT^2}$
B. $Z = \frac{RT}{PV}$
[✓ C]. $Z = \frac{PV}{RT}$
D. $Z = \frac{PT}{RV}$

Q.33 **Which of the following gases has the lowest r.m.s velocity at 25°C.?**

A. SO_2
B. N_2
C. O_2
[✓ D]. Cl_2

Q.34 **Critical temperature for different gases is different and depends upon**

A. Size of molecule
B. Shape of molecule
C. Intermolecular attractions
[✓ D]. All of the above

Q.35 **"a" is called co-efficient of attraction in Van der Waal's equation for real gases the unit of "a" is**

A. $Nm^{-4}mol^{-2}$
B. $Nm^{+6}mol^{-2}$
[✓ C]. $Nm^{+4}mol^{-2}$
D. $Nm^{+2}mol^{-2}$

Q.36 **The highest temperature at which a substance can exist as a liquid is called its**

[✓ A]. Critical temperature
B. Standard temperature
C. Absolute temperature
D. Upper consulate temperature

Q.37 **Very very small values of Van der Waal's constant in his equation for a particular gas show that**

A. The molecules of the gas are big sized
B. Gas is sufficiently polar
[✓ C]. Least attractive forces are present among the molecules of the gas
D. The gases are non-ideal

Q.38 **Excluded volume is ______ times the actual volume of gas molecules**

A. Two
B. Three
[✓ C]. Four
D. Eight

Q.39 **The constant 'a' in Van der Waal's equation is maximum for**

A. Helium
B. Hydrogen
C. Oxygen
[✓ D]. Ammonia

Q.40 **The average kinetic energy of the gas molecules is**

A. Inversely proportional to its absolute temperature
[✓ B]. Directly proportional to its absolute temperature
C. Equal to the square of its absolute temperature
D. Directly proportional to the square root of its absolute temperature

PAST PAPER QUESTIONS

Q.1 **All the collisions between the particles of gases are elastic in nature. What is meant by "Elastic Collisions"?** **MDCAT (2019)**

A. The velocity of the molecules changes
B. No change in mass during the collisions
[✓ C. No change in the kinetic energy]
D. No change in potential energy during the Collisions

Q.2 **Which one of the following expression represent the Avogadro law?** **MDCAT (2010)**

A. V= RnT/P (When T and n are constant)
[✓ B. V= RnT/P (When T and P are constant)]
C. V= RnT/P (When P and n are constant)
D. V= RP/nT (When T, P and n are constant)

Q.3 **The root mean square velocity of gases is inversely proportional to square root of their:** **MDCAT (2010)**

A. Temperature
B. Pressure
[✓ C. Molar mass]
D. Volume

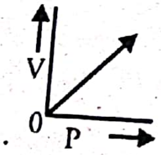
Q.4 **The number of molecules in 22.4 dm^3 of H_2 gas at 0°C and 1 atm are** **MDCAT (2012)**

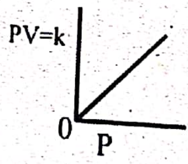
A. 60.2×10^{23}
B. 6.02×10^{25}
[✓ C. 6.02×10^{23}]
D. 60.2×10^{22}

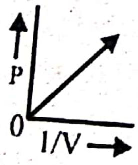
Q.5 **There are four gases H_2, He, N_2 and CO_2 at 0°C. Which gas shown greater non-ideal behavior?** **MDCAT (2013)**

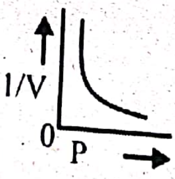
A. He
B. H_2
[✓ C. CO_2]
D. N_2

Q.6 **Which graph represents Boyle's law** **MDCAT (2015)**

A.


B.


[✓ C.]


D.


Q.7 **Identify the value of R at STP** **MDCAT (2017)**

A. 8.314 atm dm^{-3} mol^{-1}
[✓ B. 0.0821 atm dm^3 K^{-1} mol^{-1}]
C. 0.0821 cal K^{-1} mol^{-1}
D. 8.314 cal K^{-1} mol^{-1}

Q.8 **In the equation $\left(P+\frac{n^2a}{V^2}\right)(V-nb)=RT$, 'b' represents the** **MDCAT (2017)**

A. Excluded volume
B. Actual volume
C. Excluded pressure
[✓ D. Excluded volume per mole]

Q.9 **Gas is enclosed in a container of $20 cm^3$ with the moving piston. According to kinetic theory of gases, what is the effect on freely moving molecules of the gas if temperature is increased from 20°C to 100°C?** **MDCAT (2018)**

A. Colliding capability of molecule will become lower

B. Pressure will become one half

C. Temperature has no effect on freely moving molecules

[✓ D. Volume will be increased]

Q.10 **Which of the following is the correct equation to calculate relative molecular mass of a gas** **MDCAT (2018)**

A. M = mPRT/V

B. M = mPR/VT

C. M = PV/mRT

[✓ D. M = mRT/PV]

Q.11 **Which of the statement is applicable for both ideal and real gases molecules?** **SET (2019)**

A. Have no forces of attraction

B. Collisions between the molecules is elastic

✓ [✓ C. Molecules are in random movement]

∝ [✓ D. The actual volume of gas is negligible as compared to the volume of gas]

Q.12 **At absolute zero the molecules of hydrogen gas will have** **ETEA (2016)**

A. Only translational motion

B. Only vibrational motion

C. Only rotational motion

[✓ D. All the motion are cased]

Q.13 **According to the general gas equation, density of an ideal gas depends upon:** **NMDCAT (2020)**

A. Pressure

B. Temperature

C. Molar mass of the gas

[✓ D. All of the above]

Q.14 **The actual volume of gas molecules is considered negligible at following pressures.** **NMDCAT (2020)**

[✓ A. 2 atm]

B. 4 atm

C. 6 atm

D. 8 atm

ANSWER KEY

1	C	11	C	21	D	31	B
2	B	12	A	22	A	32	C
3	C	13	D	23	A	33	D
4	C	14	A	24	C	34	D
5	A	15	C	25	D	35	C
6	A	16	C	26	B	36	A
7	B	17	B	27	D	37	C
8	D	18	B	28	D	38	C
9	C	19	C	29	C	39	D
10	D	20	C	30	D	40	B

PAST PAPER QUESTIONS

1	C	6	C	11	C
2	B	7	B	12	D
3	C	8	D	13	D
4	C	9	D	14	A
5	C	10	D		

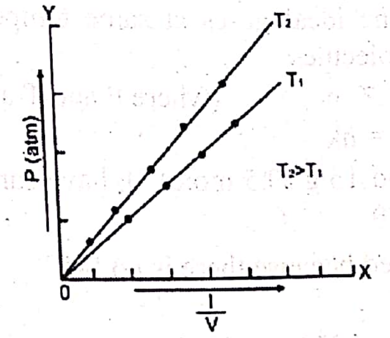
EXPLANATORY NOTES

Q.1 According to Boyle's law: The volume of a given mass of a gas is inversely proportional to the applied pressure at constant temperature. (V α 1/P)

Q.2

$$d = \frac{PM}{RT}$$

Q.3



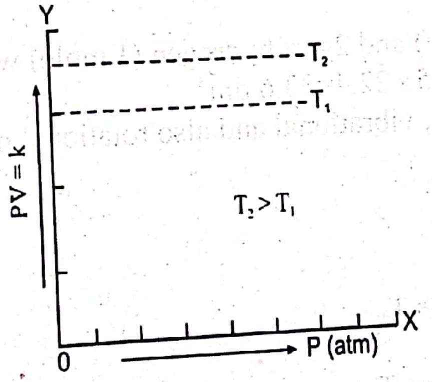
Q.4 The equation to know the volumes of the gas at various temperatures is

$$V_o = V_t\left(1 + \frac{t^\circ C}{273}\right)$$

Where, V_t = Volume of gas at temperature t.
V_o = Volume of gas at 0°C.
t = Temperature on Celsius scale.

Q.5 A mono-atomic substance can store energy only in the form of translational motion

Q.6



Q.7 If both temperature and volume of a gas are doubled, the pressure remain unchanged because V α 1/P and V α T

Q.8 All of the following are the form of general gas equation

- $PV = nRT$ (for "n" number of moles)
- $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$
- $PV = RT$ (for 1 mole of gas)

Topic-3

Q.9 According to Charles law: The volume of the given mass of a gas is directly proportional to the absolute (Kelvin) temperature at constant pressure.

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\frac{10}{273} = \frac{30}{T2}$$

$$T_2 = \frac{30\times273}{10}$$

$$T_2 = 819 \text{ K}$$

Q.10 Equal volumes of all the ideal gases at same temperature and pressure contain equal number of moles and molecules.

$V \propto n$ (where P and T are constant)

$V = nk$

Both 0.5 mole of NO and 16 g (0.5 mole) O_2 have same number of moles therefore they have equal volume at STP

Q.11 Ideal gas can't be liquefied because there is no IMF

Q.12 $E_k \propto T$

$T_1 = 27°c = 300$ K, $T_2 = 327°c = 600$ K

When temperature is doubled, K.E becomes double.

Q.13 $R = 8.3143 \text{ Nm.mol}^{-1}.\text{K}^{-1}$

$1\text{Nm} = 10^7 \text{ erg}$

Hence $8.134\times10^7 \text{ erg. mol}^{-1}.\text{K}^{-1}$

Q.14 In gases and liquids, temperature is the measure of average translational kinetic energies of molecules

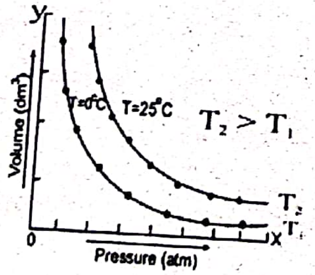
Q.15 Molar volume is maximum when temperature is high and pressure is low.

$V \alpha 1/P$ and $V \alpha T$

Q.16 8g of methane (0.5 mole) and 2g of hydrogen (1 mole) will occupy total volume $1.5\times$ molar volume $= 1.5\times22.4=33.6 \text{ dm}^3$

Q.17 Gases have translational, vibrational and also rotational motion.

Q.18



Q.19 $1.01325\text{Bar} = 1\text{atm}$

$0.101325\text{Bar} = 0.1 \text{ atm}$

Q.20 Dimensions of the pressure are the same as that of energy per unit volume

Q.21 At high pressure, molecules come closer to each other and inter-molecular attractions become significant.

Q.22 More will be ideality in character of a gas

- Less IMF
- Non-polar
- Small size
- Smaller mass
- Small values of a and b (Van der Waal's Constants)

Q.23 Volume increases with the increase in temperature at constant pressure. ($V \alpha T$)

Q.24 The product of PV of a gas has unit of work i.e. J (Joule)

Q.25 A real gas behaves like an ideal gas at high temperature and low pressure.

Q.26 Absolute temperature of a gas is directly proportional to average translational K.E

Q.27 An ideal gas can't be liquefied because forces between its molecules are negligible

Q.28 The compressibility factor, Z, for an ideal gas is equal to one

Q.29 $R = 0.0821 \text{ atm dm}^3\text{mol}^{-1}.\text{K}^{-1}$

Q.30 In a closed container, there will be no change in the quantity (number of moles) of the gas.

Q.31 A pressure of a gas is due to Molecular impacts against the walls of vessel

Q.32 $Z = \frac{PV}{RT}$

Q.33 $C_{rms} = \sqrt{\frac{3RT}{M}}$ or $\sqrt{\frac{3PV}{M}}$

Cl_2 as maximum molar mass therefore it has lowest r.m.s velocity.

Q.34 Critical temperature for different gases is different and depends upon size of molecule, shape of molecule and intermolecular attractions

Q.35

$$P = an^2/V^2$$
$$a = PV^2/n^2$$
$$a = \frac{Nm^{-2} \times (m^3)^2}{(mol)^2}$$
$$a = Nm^{-2}.\ m^6.mol^{-2}$$
$$\mathbf{a = Nm^{+4}mol^{-2}}$$

Q.36 The highest temperature at which a substance can exist as a liquid is called its critical temperature

Q.37 Very very small values of Van der Waal's constant in his equation for a particular gas show that least attractive forces are present among the molecules of the gas.

Q.38 $b = 4\ V_m$

Where, V_m is the actual volume of gas molecules.

Q.39 'a' is a constant of proportionality and is called co-efficient of attraction or attraction per unit volume. It has a constant value for a particular real gas. Ammonia has hydrogen bonding (strong IMF)

Q.40 The average kinetic energy of the gas molecules is directly proportional to its absolute temperature

Topic-3

EXPLANATORY NOTES

(PAST PAPER QUESTIONS)

Q.1 When the particles of gas collide, they do not loss or gain any kinetic energy, which means that their kinetic energy do not change so it is elastic collision.

Q.2 $V = RnT/P$
$V = (RT/P)\, n$
$V = (\text{constant})\, n$ (If temperature and pressure are kept constant)
$V \propto n$ (Avogadro's Law)

Q.3

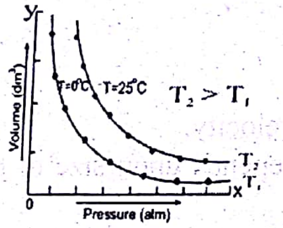
$$C_{rms} = \sqrt{\frac{3RT}{M}}$$

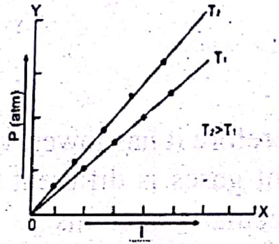
$$C_{rms} \propto \sqrt{\frac{1}{M}}$$

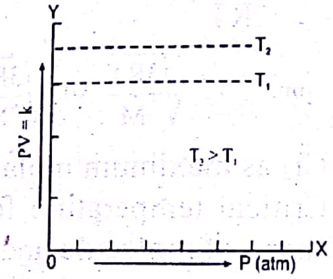
Q.4 At STP one mole hydrogen gas (H_2) has 22.414dm^3 volume and has 6.02×10^{23} molecules

Q.5 Due to large size of CO_2 molecule, it shows greater intermolecular force and show most non-ideal behavior.
The order of non-ideality is: $He < H_2 < N_2 < CO_2$

Q.6 Following are the different graphs of Boyle's law.







Q.7 At STP following are the values of R in different units
0.0821 atm $dm^3\,K^{-1}\,mol^{-1}$
8.31 Nm $K^{-1}\,mol^{-1}$
8.31 J $K^{-1}\,mol^{-1}$
7.989 cal $K^{-1}\,mol^{-1}$

Q.8 In Van der Waal's equation for real gases, b represents excluded volume per mole

Q.9 At constant pressure, by increasing temperature, volume of gas increases.

Q.10 The correct formula to calculate the relative molecular mass of a gas is

$$M = \frac{mRT}{PV}$$

Q.11 The molecules of both ideal and non-ideal gas move randomly.

Q.12 At zero kelvin (absolute zero) molecular motion of gases ceases.

Q.13 Density of a gas depends upon pressure(P), temperature(T), molecular mass(M) and ideal gas constant R.

$$d = \frac{PM}{RT}$$

Q.14 At low pressure, actual volume of gas molecule is negligible.

Topic 4

LIQUIDS

PRACTICE EXERCISE

Q.1 $CHCl_3$ exist in liquid state due to
A. Dipole-dipole and London dispersion forces
B. Dipole induced dipole forces
[✓ C. Dipole–dipole forces]
D. Hydrogen bonding

Q.2 The highest boiling point among the following is for
A. NH_3
[✓ B. Br_2]
C. $CHCl_3$
D. Xe

Q.3 In NH_3, dominant Van der Waal's force among following is
A. London dispersion forces
B. Dipole induced dipole forces
C. Dipole–dipole forces
[✓ D. Hydrogen bonding]

Q.4 Liquids have no definite shape; it is because
[✓ A. The molecules of liquid are in constant motion by sliding over each other]
B. The intermolecular forces of liquids are weaker than gases
C. The liquid molecules have kinetic energy less than solids
D. All statements are correct

Q.5 Propanone is miscible in water due to
A. Both are polar molecules
B. Hydrogen bonding between them
C. Dipole-dipole attraction between them
[✓ D. All of these]

Q.6 Strong dipole-dipole forces among the liquid molecules are responsible for
[✓ A. Very high heat of vaporization]
B. Very low boiling point
C. Very low heat of vaporization
D. All are correct

Q.7 Which one of the following arrangements usually represents the correct order of increasing interactions?
A. Hydrogen bonding, London forces, Dipole – Dipole
[✓ B. London force, Hydrogen bonding, Dipole – Dipole]
C. London forces, Dipole – Dipole, Hydrogen bonding
D. Dipole – Dipole, London forces, Hydrogen bonding

Q.8 Which of the following has strongest intermolecular forces of attraction
A. Hydrogen(H_2)
B. Chlorine (Cl_2)
[✓ C. Iodine (I_2)]
D. Methane (CH_4)

Q.9 The forces which are present between the ions and water molecules are known as
A. Dipole induced dipole forces
[✓ B. Ion dipole forces]
C. Dipole-dipole forces
D. London dispersion forces

Q.10 Forces of attraction, which may be present between all kinds of atoms and molecules are
A. Hydrogen bonding
B. Di-pole di-pole forces
[✓ C. London dispersion forces]
D. Dipole-induced dipole

Q.11 The attractive forces between the partial positive end of one molecule and partial negative end of other molecule are called
[✓ A. Dipole-dipole forces]
B. Ion dipole-dipole forces
C. London dispersion forces
D. Debye forces

Q.12 Liquid gets the shape of the container when it is poured into it. Which one of the following reason justifies it
[✓ A. Liquid do not have definite shape]
B. Liquid do not have definite volume
C. Liquid is highly compressible
D. Liquid molecules can slide over each other

Q.13 Nature of bonding affects the properties like:

A. Solubility
B. Melting, boiling points and isomerism
C. Reaction kinetics
[✓ D. All of these]

Q.14 Vapour pressure of water is 4.579 torr at 0°C and 9.209 torr at 10°C, so increase in vapour pressure from 0°C to 10°C is 4.630 torr. What will be the change in vapour pressure from 90°C to 100°C

A. 4.630 torr
B. < 4.630 torr
[✓ C. > 4.630 torr]
D. V.P remain same at all Temperature

Q.15 Which of the following has highest vapour pressure

A. Water
B. Mercury
C. Glycerol
[✓ D. Isopentane]

Q.16 The boiling point of water would be highest at

A. Murree
[✓ B. Gawadar]
C. Mount everest
D. Siachin

Q.17 Which one is false for evaporation

A. Surface phenomenon
B. Continuous
[✓ C. Exothermic]
D. Causes cooling

Q.18 Vapour pressure of water at 100°C is

A. 55 mm Hg
[✓ B. 760 mm Hg]
C. 355 mm Hg
D. 1489 mm Hg

Q.19 The conversion of vapours back into their liquid state is called

A. Crystallization
B. Evaporization
C. Vapourization
[✓ D. Condensation]

Q.20 Which one of the following has highest volatility

[✓ A. Diethyl ether]
B. Ethyl alcohol
C. Water
D. Ethylene glycol

Q.21 In order to mention the boiling point of water at 110°C, the external pressure should be

[✓ A. Between 760 torr and 1200 torr]
B. Between 200 torr and 760 torr
C. 765 torr
D. Any value of pressure

Q.22 The boiling point increases down the zero group element due to

A. Ion dipole forces
[✓ B. London forces]
C. Hydrogen bonding
D. Dipole-dipole forces

Q.23 If we provide very high amount of heat to a liquid its boiling point will

A. Increase
[✓ B. Remains constant]
C. Decrease
D. There will be no boiling

Q.24 Evaporation is designated as a cooling process because of the reason

A. It is a surface phenomenon
[✓ B. It is exothermic process]
C. High energy molecules leave behind the low energy molecules and cause cooling
D. All of the above

Q.25 Vapour pressure of a liquid depends upon the following

A. Surface area and temperature only

B. Volume of the liquid

C. Humidity of the liquid in the air

[✓ D]. Temperature and the inter-molecular forces

Q.26 At 1atm pressure, a liquid 1 has the boiling point less than a liquid 2, what can we predict about both the liquids

A. Liquid 1 has high vapour pressure than the liquid 2

B. Liquid 1 has the weak intermolecular forces of attraction than the liquid 2

C. Liquid 1 is more volatile than the liquid 2

[✓ D]. All of the above

Q.27 The distillation of a solution under reduced pressure is called

A. Fractional distillation

B. Distillation

C. Destructive distillation

[✓ D]. Vacuum distillation

Q.28 A pressure cooker reduces cooking time because

A. Large flame is used

[✓ B]. Boiling point of water rises

C. Heat is uniformly distributed

D. Vapour pressure of liquid decreases

Q.29 Molar heat of vapourization of water is

[✓ A]. 40.6 kJ mol^{-1}

B. 140.6 kJ mol^{-1}

C. 14.6 kJ mol^{-1}

D. Zero

Q.30 Rate of evaporation of a liquid does not depend on

A. Surface area of liquid

B. Temperature

C. Inter molecular forces

[✓ D]. All of these

Q.31 Which one of the following would cause severe burning

A. Boiling water at 90°C

[✓ B]. Steam at 100°C

C. Boiling water at 80°C

D. Water at 20°C

Q.32 The boiling point of a liquid is that temperature at which

[✓ A]. The vapour pressure of the liquid is equal to the atmospheric pressure

B. The vapour pressure of the liquid is less than the atmospheric pressure

C. The vapour pressure of the liquid is greater than the atmospheric pressure

D. The vapour pressure of the liquid is equal to intermolecular forces of liquid molecule

Q.33 The strength of hydrogen bonding is

[✓ A]. 20 times less than a covalent bond

B. 20 times less than a ionic bond

C. 20 times more than a covalent bond

D. 20 times more than a ionic bond

Q.34 When ammonia is dissolved in water, number of hydrogen bonds formed by ammonia are

[✓ A]. 1

B. 2

C. 4

D. 3

Q.35 **Lower alcohols are soluble in water because**

[✓ A. Intermolecular hydrogen bonding]
B. Dipole induced dipoles
C. Low electro-negativity difference between C and H
D. All of the above

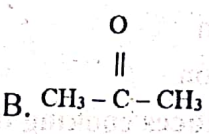
Q.36 **The strongest H-bond is**

[✓ A. F---H] B. O----H
C. N----H D. O----F

Q.37 **When two ice cubes are passed over each other, they unite to form one cube. This is due to**

A. Covalent attraction B. Ionic bond formation
[✓ C. Hydrogen bond formation] D. Metallic bond formation

Q.38 **Which of the following can form hydrogen bonding among its molecules more prominently**

[✓ A. CH_3OH]
B.

$CH_3-\overset{\overset{\displaystyle O}{\|}}{C}-CH_3$
C. $CHCl_3$
D. All of these

Q.39 **Hydrogen bonding is involved in**

A. Solubility B. Cleansing action of detergents
C. Biological molecules [✓ D. All]

Q.40 **When water freezes at 0°C its density decreases due to**

A. Change of bond angles
[✓ B. Cubic structure of ice]
C. Empty space present in the structure of ice
D. Change of bond length

PAST PAPER QUESTIONS

Q.1 Correct order of boiling points of the given liquids is **MDCAT (2012)**

A. $H_2O > HF > HCl > NH_3$

[✓ B. $H_2O > HF > NH_3 > HCl$]

C. $HF > H_2O > HCl > NH_3$

D. $HF > H_2O > NH_3 > HCl$

Q.2 At 1489 mmHg, water will boil at **NUMS (2019)**

[✓ A. 120C°]

B. 110C°

C. 100C°

D. 90C°

Q.3 Ice is less dense than water at **MDCAT (2014)**

[✓ A. 0°C]

B. 4°C

C. -4°C

D. 2°C

Q.4 In crystal lattice of ice, each O-atom of water molecule is attached to **MDCAT (2014)**

[✓ A. Four H-atoms]

B. Two H-atoms

C. One H-atom

D. Three H-atoms

Q.5 What is reason that the ice at 0°C occupies more volume then water: **MDCAT (2017)**

[✓ A. Empty spaces]

B. Intermolecular forces

C. Ionic bond

D. Debye forces

Q.6 Water has maximum density at **NUMS (2019)**

A. –4°C

B. 1°C

C. 0°C

[✓ D. 4°C]

Q.7 DNA molecule is double stranded, in which two chains of DNA are twisted around each other by: **MDCAT (2011)**

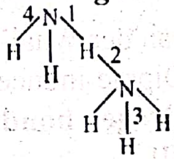
[✓ A. Hydrogen bonds]

B. Van der Waal's forces

C. Covalent bonds

D. Dative bonds

Q.8 Which bond in the following structure represents hydrogen bonding? **MDCAT (2017)**



A. 1

[✓ B. 2]

C. 3

D. 4

Q.9 Which of the following substances exhibits hydrogen bonding? **MDCAT (2019)**

A. H_2S

B. HI

[✓ C. NH_3]

D. SiH_4

Q.10 In 'H-F' bond Electronegativity difference is 2.0. What is the type of this bond? **MDCAT (2012)**

[✓ A. Polar covalent bond]

B. pi (π) bond

C. Non-polar covalent bond

D. Co-ordinate covalent bond

Q.11 Boiling point of water is higher than petrol , because intermolecular forces in water are: **MDCAT (2011)**

A. Weaker than petrol

[✓ B. Stronger than petrol]

C. Same as in petrol

D. Negligible

Q.12 **Metallic conduction involves the relatively free movement of their------------ throughout the metallic lattice:** **MDCAT (2010)**

A. Atoms
[✓ B. Electrons]
C. Ions
D. Molecules

Q.13 **Which type of force is present in gasoline?** **MDCAT (2010)**

A. Dipole-dipole forces
B. Hydrogen bonding
C. Dipole-induced dipole forces
[✓ D. London dispersion forces]

Q.14 **Which one of the following hydrogen bond is stronger than others?** **MDCAT (2015)**

A. $N^{\delta-} - H^{\delta+} \cdots\cdots\cdots N^{\delta-} - H^{\delta+}$
B. $O^{\delta-} - H^{\delta+} \cdots\cdots\cdots O^{\delta-} - H^{\delta+}$
[✓ C. $F^{\delta-} - H^{\delta+} \cdots\cdots\cdots F^{\delta-} - H^{\delta+}$]
D. $N^{\delta-} - H^{\delta+} \cdots\cdots\cdots O^{\delta-} - H^{\delta+}$

Q.15 **An inter molecular force of attraction X is relatively stronger than the other inter molecular forces, it stabilizes ∝helix and β-pleated sheets of proteins. The double helical structure of DNA is also stabilized by this force of attraction. Identify X.** **MDCAT (2019)**

A. Dipole dipole attraction
[✓ B. Hydrogen bonding]
C. Ionic interactions
D. van der Waal's Forces

Q.16 **At higher altitude, the boiling point water is less than 100°C, this is because of** **ETEA (2019)**

A. Higher atmospheric pressure
C. Weak hydrogen bonding
B. No change in atmospheric pressure
[✓ D. Lower atmospheric pressure]

Q.17 **Steam causes severe burns than boiling water. It is due to** **ETEA (2019)**

A. Absence of hydrogen bonding
[✓ C. High latent heat of vaporization]
B. Freely moving molecules
D. Statement is incorrect

Q.18 **According to Watson and Crick's model of DNA, the DNA molecule consists of a double helix. What type of forces are responsible to keep two strands of DNA together?** **MDCAT (2019)**

[✓ A. Hydrogen bonding]
B. van der Waal's forces
C. Ionic bonding
D. Dipole-induces dipole forces

Q.19 **Which of the following substances exhibits hydrogen bonding?** **MDCAT (2019)**

A. H_2S
B. HI
[✓ C. NH_3]
D. SiH_4

Q.20 **CO_2 and SO_2 both are tri-atomic molecules but heat of vaporization of SO_2 is greater than that of CO_2 due to** **NMDCAT (2020)**

A. High electronegativity of S
B. Greater size of SO_2
[✓ C. SO_2 is polar and CO_2 is non polar]
D. SO_2 is more acidic than CO_2

Q.21 **Which of the following has the lowest vapor pressure at 20°C?** **NMDCAT (2020)**

A. Diethyl ether
B. Chloroform
C. Carbon tetrachloride
[✓ D. Water]

Q.22 **Which of the following is not a molecular solid?** **NMDCAT (2020)**

[✓ A. Bromine]
B. Sulphur
C. Phosphorus
D. Carbon dioxide

ANSWER KEY

1	C	11	A	21	A	31	B
2	B	12	A	22	B	32	A
3	D	13	D	23	B	33	A
4	A	14	C	24	B	34	A
5	D	15	D	25	D	35	A
6	A	16	B	26	D	36	A
7	B	17	C	27	D	37	C
8	C	18	B	28	B	38	A
9	B	19	D	29	A	39	D
10	C	20	A	30	D	40	B

PAST PAPER QUESTIONS

1	B	6	D	11	B	16	D	21	D
2	A	7	A	12	B	17	C	22	A
3	A	8	B	13	D	18	A		
4	A	9	C	14	C	19	C		
5	A	10	A	15	B	20	C		

EXPLANATORY NOTES

Q.1 $CHCl_3$ is a polar molecule which have dipole - dipole forces.

Q.2 IMF ↑ V.P ↓ B.pt ↑

Br_2 has strong LDF due to greater molar mass.

Q.3 Hydrogen bonding is present in FON

When hydrogen is bonded with highly EN element like F, O and N, hydrogen bonding is dominant in such compound.

Q.4 Constant state of random motion in molecules of liquids and gases do not allow a definite shape.

Q.5 Both propanone and water are polar molecules, therefore, they are miscible with each other. They can form hydrogen bond also.

Q.6 IMF ↑ V.P ↓

Q.7 Generally, the order of increasing interactions is

London forces < Debye forces < Dipole – Dipole < Hydrogen bonding

Q.8 Molar mass ↑ polarizability ↑ LDF ↑

Q.9 The forces which are present between the ions and water molecules are known as ion- dipole forces.

Q.10 Force of attraction present between all kind of atoms and molecules are known as London dispersion forces.

Q.11 The attractive forces between the partial positive end of one molecule and partial negative end of other molecule are called dipole-dipole forces

Q.12 Due to presence of random motion liquid has no definite shape.

Q.13 Nature of bounding affects the physical as well as chemical properties of compound.

Q.14 Vapor pressure depends on temperature, at higher temperature greater vapor pressure is observed.

Q.15 Vapour pressure is inversely proportional to intermolecular forces

Name of compound	Vapour pressure at 20°C (torr)
Isopentane	580
Ethyl ether	442.2
Chloroform	170
Carbon Tetrachloride	87
Water	17.54
Mercury	0.012
Glycerol	0.00016

Q.16 Boiling point of liquid ↑ External pressure ↑

The boiling point of water would be highest at Gawadar

Q.17 **Evaporation:**

- is a surface phenomenon
- is a continuous process
- continues at all temperatures.
- is cooling process
- endothermic process

Q.18 Vapor pressure of water at difference temperature is given in the table

Temperature (°B.	Vapour Pressure (Torr)
0	4.579
10	9.209
20	17.54
30	31.82
37	47.07
40	55.32
50	92.51
60	149.4
70	233.7
80	355.1
90	527.0
100	760.0

Q.19 The conversion of vapours back into their liquid state is called condensation

Q.20 The correct option is Diethyl ether because

LDF ↓ V.P ↑ Volatility ↑

Q.21 Boiling point of liquid ↑ External pressure ↑

Q.22 Down the group

Molar mass ↑ polarizability ↑ LDF ↑ Boiling point ↑

Q.23 At boiling point, on supply of further amount of it no change in temperature is observed because extra amount of heat just change the liquid into vapor phase

Q.24 Evaporation is designated as a cooling process because of high energy molecules leave behind the low energy molecules and cause cooling.

Q.25 Vapour pressure of a liquid depends upon nature of liquid, temperature and the inter molecular forces. Vapour pressure α T and V.P α1/ IMF

Q.26 B.pt ↓ V.P ↑ IMF ↓ Volatility ↑

Q.27 The distillation of a solution under reduced pressure is called vacuum distillation

Q.28 A pressure cooker reduces cooking time because boiling point of water rises Boiling point ↑ External pressure ↑

Q.29 Molar heat of vapourization of water is 40.6 kJ mol^{-1}

Q.30 Rate of evaporation of a liquid depends on surface area of liquid, inter molecular forces and temperature

Q.31 Steam contains higher potential energy because of extra heat which is absorbed by water molecules during boiling to overcome intermolecular force.

Q.32 The boiling point of a liquid is that temperature at which the vapour pressure of the liquid becomes equal to the atmospheric pressure

Q.33 The strength of hydrogen bonding is 20 times less than a covalent bond.

Q.34 Number of hydrogen bonds per molecule are

NH_3----- 1 H- bond per molecule

HF----- 1 H- bond per molecule

H_2O-----2 H- bond per molecule

Q.35 Hydrogen bonding's effect decreases as the length of chain increases

Q.36 Strength of H – bond ↑ Electronegative difference ↑

Q.37 Ice (water) has strong hydrogen bonding due to which ice cubes unite to form single larger ice cube.

Q.38 CH_3OH has hydrogen bonding as prominent intermolecular force

Q.39 Solubility, cleansing action of detergents and biological molecules are application of hydrogen bonding.

Q.40 When water freezes at 0°C its density decreases due to empty space present in the structure of ice and volume increases by 9 %.

EXPLANATORY NOTES»

(PAST PAPER QUESTIONS)

Q.1 Greater the strength of IMF greater will be the boiling point. B.P of H_2O and HF is greater than that of HCl. As, H_2O and HF and NH_3 show hydrogen bonding and HCl have simple dipole-dipole force.

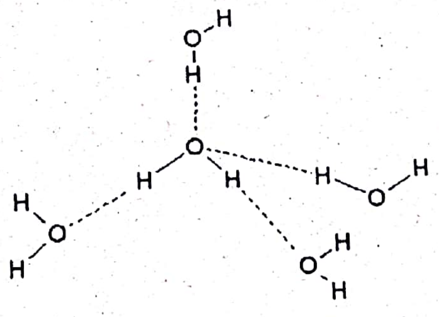
Compound	IMF	Boiling Point (°C)
H_2O	H-Bonding	100
HF	H-Bonding	19.5
NH_3	Dipole-Dipole force	-33
HCl	Dipole-Dipole force	-85

Q.2

Boiling Point of Water		
External Pressure (mmHg)	**Boiling Point (°C)**	
23.7	25	Room Temperature
323	69	At Mount Everest
700	98	At Murree
760	100	At sea level
1489	120	In Pressure Cooker

Q.3 Water has maximum density at 4°C. When temperature of water decreases it's density increases. At 0°C water is denser than ice.

Q.4 In structure of ice, one oxygen atom is trapped between 4 hydrogen atoms among which two hydrogen atoms are covalently bounded and other two forms hydrogen bonds.



Q.5 Due to empty spaces present within the lattice of ice, ice occupies 9% more volume than liquid water.

Q.6 Water has maximum density at 4°C. Above and below this temperature, density of water decreases.

Q.7 Hydrogen bond is present between two chains of DNA structure.

Q.8 Hydrogen bond in ammonia molecule is present between nitrogen atom of one molecule and hydrogen atom of another molecule.

Q.9 Three elements F, O and N which are highly electronegative forms hydrogen bond with hydrogen. Hydrogen bonding is found in HF, NH_3 and H_2O.

Q.10 In HF, a highly polar covalent bond is present between H and F atom.

Q.11 Water has stronger IMF (Hydrogen bond) whereas petrol has weaker intermolecular force (LDF).

Q.12 Metallic conduction is due to flow of free electrons in metallic lattice.

Q.13 Gasoline is mixture of different hydrocarbons. London dispersion force is present in it.

Q.14 Hydrogen bond is strongest between $F^{\delta-}$ and $H^{\delta+}$ atom due to high electronegativity difference.

Q.15 Hydrogen Bonding is present in DNA and protein structure.

Q.16 B.P $\propto$ External Pressure

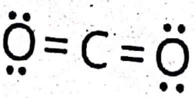
At higher altitude, atmospheric pressure decreases which results in decrease in B.P.

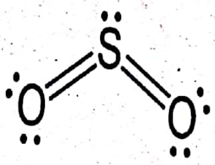
Q.17 Steam has high latent heat of vaporization due to which it can severely burn skin than boiling water. Boiling water has maximum temperature of 100°C whereas steam can have temperature more than 100°C.

Q.18 Hydrogen bonding is responsible to keep two strands of DNA together.

Q.19 Three elements F, O and N which are highly electronegative forms hydrogen bond with hydrogen. Hydrogen bonding is found in HF, NH_3 and H_2O.

Q.20 CO_2 is non-polar, it has zero dipole moment and weak IMF. So, it has low B.P. Whereas SO_2 is polar molecule with dipole moment 1.62D. So, it has relatively strong IMF and high B.P.





Q.21 IMF $\uparrow$ V.P $\downarrow$ B.P $\uparrow$

Water has strong IMF and it has lowest vapor pressure.

Q.22 Br_2 is liquid at room temperature.

Topic 5

SOLIDS

PRACTICE EXERCISE

Q.1 Transition temperature is shown by which of the following pairs
A. Isomorph and polymorph
[✓ B. Allotrope and polymorph]
C. Isomorph and allotrope
D. All of these

Q.2 Lattice energy decreases with the increase in size of ion because oppositely charged ions
A. Have close packing
B. Have low empty spaces
[✓ C. Becomes less tight]
D. Have strong electrostatic forces

Q.3 Ionic solids are characterized by
A. Low melting point
B. Good conductivity in solid state
C. High vapour pressure
[✓ D. Solubility in polar solvent]

Q.4 Which solids are called true solids
A. Metallic
B. Amorphous
[✓ C. Crystalline]
D. Vitreous

Q.5 Which ionic solid has highest lattice energy
[✓ A. LiCl]
B. NaCl
C. KCl
D. CsCl

Q.6 Which of the following intermolecular forces are present in solid iodine
A. Dipole – dipole forces
[✓ B. London dispersion forces]
C. Hydrogen bonding
D. Debye forces

Q.7 Which of the following is not amorphous solid
A. Glass
[✓ B. Table salt]
C. Glue
D. Rubber

Q.8 Transition temperature of sulphur is
A. 13.2°C
B. 128°C
[✓ C. 95.5°C]
D. 32.02°C

Q.9 Which of the following is isotropic property
A. Refractive index
B. Coefficient of thermal expansion
C. Cleavage
[✓ D. Metallic conduction]

Q.10 When an element exist in more than one crystalline forms, it is known as
A. Anisotropy
B. Isomorphism
[✓ C. Allotropy]
D. Polymorphism

Q.11 A solid may be made up of
A. Atoms
B. Ions
C. Molecules
[✓ D. a, b and c]

Q.12 Which one has the highest melting point and boiling point
A. Ionic crystal
B. Molecular crystal
[✓ C. Covalent crystal]
D. Metallic crystal

Q.13 In a crystal , the atoms are located at the position of
A. Zero P.E.
B. Infinite P.E.
[✓ C. Minimum P.E.]
D. Maximum P.E.

Q.14 Which of the following is anisotropic
A. Hydrogen
[✓ B. Quartz]
C. Water
D. Rubber

Q.15 Crystalline part of otherwise amorphous solids are known as
A. Allotrope
[✓ B. Crystallites]
C. Isomorph
D. Polymorph

Q.16 Coinage metals are Cu, Ag & Au and they have ________ crystal system
[✓ A. Cubic]
B. Hexagonal
C. Tetragonal
D. Trigon

Q.17 In crystal structure of NaCl, the arrangement of Cl^- ions is

[✓ A. Face centered cubic]
B. Body centered cubic
C. Simple Cubic
D. Hexagonal

Q.18 In a crystal lattice the correct sequence of bond angles is

[✓ A. $bc = \alpha, ca = \beta, ab = \gamma$]
B. $bc = \beta, ca = \alpha, ab = \gamma$
C. $bc = \gamma, ca = \beta, ab = \alpha$
D. All are possible

Q.19 Total unit cell dimensions are

A. Seven
B. Fourteen
[✓ C. Six]
D. Thirty-two

Q.20 Cubic crystal system has the following unit cell dimensions

[✓ A. $a = b = c$ and $\alpha = \beta = \gamma = 90°$]
B. $a = b \neq c$ and $\alpha = \beta = \gamma = 90°$
C. $a \neq b \neq c$ and $\alpha = \beta = \gamma = 90°$
D. $a = b \neq c$ and $\alpha = \beta = 90°, \gamma = 120°$

Q.21 The crystalline form of white Tin is

A. Cubic
B. Hexagonal
[✓ C. Tetragonal]
D. Both a and c

Q.22 Molecular crystals are

A. Hard
B. Very hard
[✓ C. Soft]
D. Always polar

Q.23 The crystals formed due to London forces of interaction are

A. Ionic
[✓ B. Molecular]
C. Covalent
D. Metallic

Q.24 The number of Cl^- ions per units cell of a simple cubic lattice at the corner is / are

[✓ A. 1]
B. 3
C. 4
D. 6

Q.25 Which is incorrect about structure of iodine

A. Face-centered cubic
B. Metallic appearance
[✓ C. $I - I_{(g)} > I - I_{(s)}$]
D. $I - I_{(g)} < I - I_{(s)}$ Bond length

Q.26 The coordination number of each ion in NaCl is

A. 4
B. 8
[✓ C. 6]
D. 10

Q.27 The best conductors of electricity are

A. Ionic solids
[✓ B. Metallic solids]
C. Molecular solids
D. Covalent solids

Q.28 Independent molecule of NaCl may exist in

A. Solid phase
B. Molten phase
C. Liquid phase
[✓ D. Vapour phase]

Q.29 Which of the following is an example of polar molecular solid

A. Naphthalene
B. Dry ice
C. Iodine
[✓ D. Sugar]

Q.30 Solid CO_2 (Dry ice) is an example of ________ crystals

A. Covalent
B. Ionic
C. Metallic
[✓ D. Molecular]

PAST PAPER QUESTIONS

Q.1 The coordination number of Na+ in NaCl crystal is MDCAT (2010)

A. 8
B. 4
C. 2
[✓ D. 6]

Q.2 In the structure of NaCl, each sodium ion is surrounded by chloride ions MDCAT (2013)

A. 4
[✓ B. 6]
C. 5
D. 8

Q.3 Which one the following have highest lattice energy? NUMS (2019)

A. NaCl
B. KCl
C. KBr
[✓ D. LiCl]

Q.4 Electrical conductivity of graphite is greater in one direction than in other due to MDCAT (2016)

A. Isomorphism
[✓ B. Anisotropy]
C. Cleavage plane
D. Symmetry

Q.5 In diamond each of the four outer electrons on every carbon atom is involved in covalent bonding. This means that there are no free electrons available. Which of the following property is explained by this statement SET (2019)

[✓ A. Diamond does not conduct heat and electricity]
B. Diamond is very hard
C. Diamond has high refractive index
D. Diamond cuts diamond

Q.6 Graphite is one of the allotropic form of Carbon it is ETEA (2016)

A. Isotropic
B. Anisotropic
C. Good conductor of electricity
[✓ D. Both B & C]

Q.7 Substance that has sharp melting point in the following is ETEA (2019)

A. Gemstone
B. Glass
C. Coal tar
[✓ D. Diamond]

Q.8 The lattice energy is also called as NMDCAT (2020)

A. Energy of affinity
B. Bond energy
[✓ C. Crystal energy]
D. Potential energy

ANSWER KEY

1	B	11	D	21	C
2	C	12	C	22	C
3	D	13	C	23	B
4	C	14	B	24	A
5	A	15	B	25	C
6	B	16	A	26	C
7	B	17	A	27	B
8	C	18	A	28	D
9	D	19	C	29	D
10	C	20	A	30	D

PAST PAPER QUESTIONS

1	D	6	D
2	B	7	D
3	D	8	C
4	B		
5	A		

EXPLANATORY NOTES»

Q.1 Polymorphs and allotrope are different crystalline forms of compounds and elements respectively. Therefore, transition temperature is shown by them

Q.2 Lattice energy depends upon size and it is inversely proportional to size.
Lattice energy α Charge/Size

Q.3 Solubility is based on the principle, "like dissolves like"

Q.4 Only crystalline solids show all the properties of true solids.

Q.5 Lattice energy depends on charge to size ratio. Greater the charge to size ratio, greater is lattice energy. Lattice energy α Charge/Size

Q.6 Solid iodine is non-polar and have LDF.

Q.7 Table salt is NaCl which is a crystalline solid.

Q.8 Rhombic sulphur $\overset{95.5^{\circ}C}{\rightleftharpoons}$ Monoclinic sulphur

Q.9 Anisotropy is directional property while isotropy is a non-directional. Hence, metallic conduction is isotropic

Q.10 When an element exists in more than one crystalline forms, it is known as allotropy

Q.11 A solid may be made up of atoms (covalent soliD., molecules (molecular soliD. and ions (ionic soliD.,

Q.12 Covalent crystals may have network structure therefore, they have high melting and boiling points.

Q.13 Crystal is a stable geometrical shape in which atoms, molecules or ions are located at the position of minimum potential energy.

Q.14 Quartz is a crystalline solid and have anisotropic property

Q.15 Crystalline part of otherwise amorphous solids is known as crystallites

Q.16 Cu, Ag and Au have cubic crystal system.

Q.17 NaCl has FCC crystalline structure.

Q.18 The angle 'α' is between the lengths 'b' and 'c', the angle 'β' is between the sides 'a' and 'c' and angle 'γ' is between sides 'a' and 'b'.

Q.19 There are three unit cell lengths a, b and c and three unit cell angels (α, β, γ).

Q.20 Cubic $a = b = c$ $\alpha = \beta = \gamma = 90^{\circ}$
Examples: Fe, Cu, Ag, Au, NaCl, NaBr, Diamond

Q.21 Tetragonal $a = b \neq c$ $\alpha = \beta = \gamma = 90^{\circ}$
Examples: Sn, SnO_2, MnO_2, NH_4Br

Q.22 Molecular crystal is formed due to intermolecular forces which are not very strong therefore, they are soft.

Q.23 Molecular solids are formed due to LDF or hydrogen bonding.

Q.24 A unit cell gets a total share of Cl^- ion at eight corners $= 8 \times \frac{1}{8} = 1$

Q.25 I-I bond distance is 271.5 pm and it is appreciably longer than in gaseous iodine (266.6pm).

Q.26 In NaCl, each Na^+ ion surrounded by six Cl^- ions and each Cl^- ion is surrounded by six Na^+ ions.
So, co-ordination number of each ion in NaCl is 6.

Q.27 Metallic solids have delocalized electron due to which they can conduct electricity.

Q.28 Independent molecule of NaCl may exist in only vapour phase

Q.29 Sugar is a polar molecule and have hydrogen bonding.

Q.30 Dry ice is an example of molecular solid (Non-polar molecular solid.

EXPLANATORY NOTES

(PAST PAPER QUESTIONS)

Q.1 In lattice structure of NaCl, each Na^+ ion is surrounded by six Cl^- ion and vice versa. So, coordination number of Na^+ is 6.

Q.2 In NaCl, each Na^+ ion is surrounded by six Cl^- ion.

Q.3 LiCl has maximum lattice energy as it has small sized Li^+ ion. Smaller the size, greater will be lattice energy.

$$\text{Lattice Energy} \propto \frac{\text{Charge}}{\text{Size}} \propto \text{Charge density}$$

Q.4 Graphite show anisotropy in electrical conductance which means that graphite is conductor in one direction only (parallel to layer structure).

Q.5 In diamond, each carbon atom is sp^3 hybridized and no free electron is available. Due to unavailability of free electrons, diamond is non-conductor of electricity.

Q.6 Each carbon atom is sp^2 hybridized and one electron is available for conduction. But graphite shows property of anisotropy due to which it is conductor in one direction only.

Q.7 Crystalline solids have sharp melting point. Diamond is an example of crystalline solid.

Q.8 Lattice energy is also known as crystal energy.

Topic 6

CHEMICAL EQUILIBRIUM

PRACTICE EXERCISE

Q.1 **At equilibrium, the concentration of reactants and products are**

[✓ A. Constant]
B. Different
C. Maximum
D. Equal

Q.2 **Statement, which describe a reversible reaction**

A. Both forward and reverse reaction does not occur simultaneously
B. Both forward and reverse reaction occur simultaneously but under different conditions
[✓ C. Both forward and reverse reaction occur simultaneously at the same time under same condition]
D. Forward and reverse reaction takes place at different time and different conditions

Q.3 **For a homogeneous reaction**

$$4NH_3 + 5O_2 \rightleftharpoons 4NO + 6H_2O$$

The units of equilibrium constant (KB. is

A. Conc.$^{+2}$
[✓ B. Conc.$^{+1}$]
C. Conc.$^{-1}$
D. No units

Q.4 **One mole of HI was sealed in a tube heated at 440°C till equilibrium is reached, HI was found to be 50% dissociated, K_c for the reaction is**

A. 1
[✓ B. 0.25]
C. 0.5
D. 0.625

Q.5 **For what value of K_c almost forward reaction is complete**

A. $K_c = 10^{-30}$
[✓ B. $K_c = 10^{30}$]
C. $K_c = 1$
D. $K_c = 0$

Q.6 **1 mole of ethyl alcohol was treated with one mole of acetic acid at 25°C. $\frac{2}{3}$rd of acid changes into ester at equilibrium. The equilibrium constant of the reaction will be**

A. 1
B. 2
C. 3
[✓ D. 4]

Q.7 **At equilibrium, concentration of SO_2 is 2M, O_2 is 2M and SO_3 is 4M. $2SO_2 + O_2 \rightleftharpoons 2SO_3$. What will be the Kc value of given reaction**

A. 0.2
[✓ B. 2]
C. 4
D. 8

Q.8 **In a reaction $CO_{(g)} + 2H_{2(g)} \rightleftharpoons CH_3OH_{(g)}$, $\Delta H° = -92 kJ/mol$. Concentration of hydrogen, carbon monoxide and methanol become constant at equilibrium, what will happen**

A. Reaction become faster
B. Reaction become slow
C. Equilibrium state disturbs
[✓ D. Equilibrium state remains undisturbed]

Q.9 **If Kc value is very small then equilibrium position will shift**

[✓ A. Towards left]
B. Towards right
C. Remains unchanged
D. It is always constant value

Q.10 **The equilibrium expression for a reaction is $Kc = \frac{X^2}{V(a-X)}$, what is true for this reaction.**

A. Increase of pressure favoured forward reaction
[✓ B. Decrease of pressure favoured forward reaction]
C. Decrease of pressure favoured backward reaction
D. Increase in volume favoured backward reaction

Q.11 For the reaction $H_{2\,(g)} + I_{2\,(g)} \rightleftharpoons 2HI_{(g)}$. The equilibrium constant changes with

∝ [✓ A. Total pressure]
B. Catalyst
C. Concentration of H_2 and I_2
[✓ D. Temperature]

Q.12 Correct relationship b/w K_c and K_p can be written as

A. $K_p = K_c (R)^{\Delta n}$
[✓ B. $K_p = K_c (RT)^{\Delta n}$]
C. $K_c = K_p (RT)^{\Delta n}$
D. $K_p = K_c (R/N)^{\Delta n}$

Q.13 For the given reaction $PCl_5 \rightleftharpoons PCl_3 + Cl_2$

[✓ A. $K_p > K_c$]
B. $K_p = K_c$
C. $K_p < K_c$
D. $K_p = K_c = 0$

Q.14 For the reaction $H_2 + I_2 \rightleftharpoons 2HI$. Equilibrium concentration of H_2, I_2 and HI are 8,3 and 24mol/dm³ respectively. K_c of the reaction is

[✓ A. 24]
B. 1
C. 26
D. 9

Q.15 For the following reaction in the gaseous phase

$$CO + \frac{1}{2}O_2 \rightleftharpoons CO_2, \frac{Kc}{Kp} \text{ is}$$

[✓ A. $(RT)^{\frac{1}{2}}$]
B. $(RT)^{-\frac{1}{2}}$
C. RT
D. RT^{-1}

Q.16 In the reaction $A_{2(g)} + 4B_{2(g)} \rightleftharpoons 2AB_{4(g)}$ such that ΔH is negative, the formation of $AB_{4(g)}$ will be favoured at

[✓ A. Low temperature and high-pressure]
B. Low temperature and low pressure
C. High temperature and low-pressure
D. High temperature and high pressure

Q.17 $N_2 + 3H_2 \rightleftharpoons 2NH_3$ $\quad \Delta H = -41.02\text{kJ/mol}$

Forward reaction is favoured by

A. Adding NH_3 at equilibrium
B. Adding catalyst
[✓ C. Decreasing temperature]
D. Decreasing concentration of H_2

Q.18 In a given system, water and ice are in equilibrium, if the pressure is applied to the system then

A. More ice is formed
B. Amount of ice and water will remain the same
[✓ C. More ice is melted]
D. Both A. and B.

Q.19 If the temperature is increased for following reaction, then it will go in

$$N_2 + 3H_2 \rightleftharpoons 2NH_3 \qquad \Delta H = -Ve$$

A. Forward direction
[✓ B. Reverse direction]
C. Remain constant
D. Cannot be predicted

Q.20 In Haber process, equilibrium mixture contains _______ NH_3 by volume

A. 20%
B. 70%
C. 55%
[✓ D. 35%]

Q.21 Catalyst used in Haber's process for manufacturing of NH_3 is

[✓ A. Fe(MgO, Al_2O, SiO_2)]
B. Al_2O_3
C. MgO
D. SiO_2

Q.22 Basic buffer solution is

A. HF / NaF
B. H_2CO_3 / Na_2CO_3
C. $(COOH)_2$ / $(COONa)_2$
[✓ D. NH_4OH/NH_4Cl]

Q.23 **Buffer action can be explained by all except**
A. Common ion effect
B. Law of mass action
C. Le-Chatelier's principle
[✓ D. Solubility product]

Q.24 **A basic buffer solution can be prepared by mixing**
A. Strong acid and its salt with weak base
[✓ B. Weak base and its salt with strong acid]
C. Strong base and its salt with weak acid
D. Weak acid and its salt with strong base

Q.25 **The pH of ideal buffer is**
A. 10
B. Less than 7
[✓ C. 7]
D. 0

Q.26 **A certain buffer solution contains equal conc. of $\bar{X}$ and HX. Ka for HX is 10^{-8}. The pH of buffer is**
A. 3
[✓ B. 8]
C. 11
D. 14

Q.27 **Which Henderson equation is not correct?**
A. $pH = pKa + \log\frac{[salt]}{[acid]}$
B. $pH = pKa - \log\frac{[acid]}{[salt]}$
[✓ C. $pH = pKa - \log\frac{[salt]}{[acid]}$]
D. $pKa = pH - \log\frac{[salt]}{[acid]}$

Q.28 **For acidic buffer, $pH < pKa$ if**
A. $[salt] = [acid]$
B. $[salt] > [acid]$
[✓ C. $[salt] < [acid]$]
D. $[salt] > [base]$

Q.29 **When HCl gas is passed through saturated solution of rock salt, the solubility of NaCl**
A. Increases
[✓ B. Decreases]
C. May increase or decrease
D. None of these

Q.30 **An excess of silver nitrate is added to the aqueous barium chloride and the precipitate is removed by filtration. What are the main ions in the filtrate**
A. Ag^+ and NO_3^- only
[✓ B. Ag^+ and NO_3^- and Ba^{+2}only]
C. NO_3^- and Ba^{+2}only
D. Cl^- and NO_3^- and Ba^{+2}only

Q.31 **Ionization of $KClO_3$ is suppressed by**
A. Increasing temperature
B. Adding $NaNO_3$
[✓ C. Adding KCl]
D. Decreasing temperature

Q.32 **If ionic product is equal to K_{sp} then the solution is**
A. Unsaturated
B. Supersaturated
C. Ideal
[✓ D. Saturated]

Q.33 **The solubility product is only applicable for those substance whose molar concentrations is**
A. Equal to 0.1M
[✓ B. Equal to or Less than 0.01]
C. Equal to 1
D. Greater than 0.1

Q.34 **In a saturated solution of AgCl, the molar concentration of Ag^+ and Cl^- is 1.0×10^{-5} M each. What is the value of Ksp**
A. 1.0×10^{-5}
B. 1.0×10^{-15}
C. 0.1×10^{-5}
[✓ D. 1.0×10^{-10}]

Q.35 **The molar solubility of sparingly soluble salt AB_3 is "S" mol/dm³, the corresponding solubility product K_{sp} is given in term of K_{sp} by the reaction.**
A. $S = \left(\frac{K_{sp}}{128}\right)^{1/4}$
B. $S = (27K_{sp})^{\frac{1}{3}}$
[✓ C. $S = \left(\frac{K_{sp}}{27}\right)^{\frac{1}{4}}$]
D. $S = \left(\frac{K_{sp}}{81}\right)^{\frac{1}{4}}$

Topic 6

PAST PAPER QUESTIONS

Q.1 **Units of Kc for the following reaction is: $H2 + I2 \rightarrow 2HI$** **MDCAT (2010)**

A. mol^2dm^{-6} [✓ B. no unit]
C. $moldm^{-3}$ D. $mol^{-2}dm^6$

Q.2 **If in AgCl solution , some salt of NaCl is added , AgCl will be precipitated due to:** **MDCAT (2011)**

A. Solubility B.Electrolyte
C. Un saturation effect [✓ D. Common ion effect]

Q.3 **Formation of NH_3 is reversible and exothermic process, what will happen on cooling?** **MDCAT (2012)**

A. More reactant will form B. More H_2 will be formed
C. More N_2 will be formed [✓ D. More product (NH_3) will be formed]

Q.4 **A buffer solution is that which resists/minimizes the change in** **MDCAT (2012)**

A. pOH B. pK_a
[✓ C. pH] D. pK_b

Q.5 **The chemical substance, when dissolved in water, gives "H^+" is called:MDCAT (2013)**

A. Neutral B. Base
[✓ C. Acid] D. Amphoteric

Q.6 **The 'pH' of our blood is:** **MDCAT (2013)**

A. 6.7 - 8 B. 7.5
C. 7.9 [✓ D. 7.35 – 7.4]

Q.7 **The value of equilibrium constant (K_B for the reaction $2HF_{(g)} \rightleftharpoons H_{2(g)} + F_{2(g)}$ is 10^{-13} at 2000°C calculate the value of K_p for this reaction** **MDCAT (2014)**

A. 2×10^{-13} B. 186×10^{-13}
[✓ C. 10^{-13}] D. 3.48×10^{-9}

Q.8 **What will be the pH of a solution of NaOH with a concentration of 10^{-3} M?** **MDCAT (2014)**

A. 3 [✓ B. 11]
C. 14 D. 7

Q.9 **During the manufacture of nitric acid, nitric oxide is oxidized to nitrogen dioxide. This reaction is given as**

$$2NO_{(g)} + O_{2(g)} \rightleftharpoons 2NO_{2(g)} \quad \Delta H = -114kJ/mol$$

According to Le Chatelier's Principle **MDCAT (2015)**

A. Reaction must not be temperature dependent
[✓ B. Reaction must be carried out at room temperature]
C. Reaction must be carried out at low temperature
D. Reaction must be carried out at high temperature

Q.10 **What is the correct relation between pH and pKa?** **MDCAT (2015)**

A. $pH = pKa + \log\left[\frac{Acid}{Base}\right]$ B. $pH = pKa - \log\left[\frac{Base}{Acid}\right]$
[✓ C. $pH = pKa - \log\left[\frac{Acid}{Base}\right]$] D. $pKa = pH + \log\left[\frac{Base}{Acid}\right]$

Q.11 Which one of the following is the correct representation for k_{sp}? MDCAT (2015)

$$AgCl \rightleftharpoons Ag^{+} + Cl^{-}$$

A. $K_{sp} = \frac{[AgCl]}{[Ag^{+1}][Cl^{-1}]}$

B. $K_{sp} = \frac{[Ag^{+1}][Cl^{-1}]}{[AgCl]}$

[✓ C.] $K_{sp} = [Ag^{+1}][Cl^{-1}]$

D. $K_{sp} = [AgCl]$

Q.12 Human blood maintains its pH between: MDCAT (2016)

A. 6.50 – 7.00

B. 7.50 – 7.55

C. 7.20 – 7.25

[✓ D.] 7.35 – 7.40

Q.13 Value of K_{sp} for $PbSO_4$system at 25°C is equal to: MDCAT (2016)

A. 1.6×10^{-5} mol^2dm^{-6}

[✓ B.] 1.6×10^{-8} mol^2dm^{-6}

C. 1.6×10^{-6} mol^2 dm^{-6}

D. 1.6×10^{-7} mol^2dm^{-6}

Q.14 For which of the following equilibrium reaction, K_c has no units? MDCAT (2017)

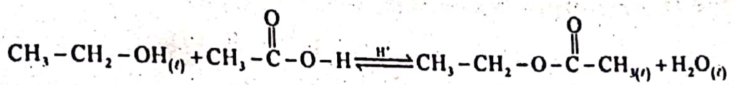
A. $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$

[✓ B.] $CO_{(g)} + H_2O_{(g)} \rightleftharpoons CO_{2(g)} + H_{2(g)}$

C. $SO_{2(g)} + 2O_{2(g)} \rightleftharpoons 2SO_{3(g)}$

D. $2NO_{2(g)} + O_{2(g)} \rightleftharpoons 2NO_{(g)}$

Q.15 Consider the following reversible reaction



$$CH_3-CH_2-OH_{(l)} + CH_3-\overset{O}{\overset{\|}{C}}-O-H \overset{H^+}{\rightleftharpoons} CH_3-CH_2-O-\overset{O}{\overset{\|}{C}}-CH_{3(l)} + H_2O_{(l)}$$

Initial concentration

$(CH_3CH_2OH) = 1mol$ $\left(CH_3-CH_2-O-\overset{O}{\overset{\|}{C}}-CH_3\right) = 0mol$

$(CH_3COOH) = 1mol$ $(H_2O) = 0mol$

Equilibrium concentration

$(CH_3CH_2OH) = 0.333mol$ $\left(CH_3-CH_2-O-\overset{O}{\overset{\|}{C}}-CH_3\right) = 0.666mol$

$(CH_3COOH) = 0.333mol$ $(H_2O) = 0.666mol$

$K_c = 4$ at 100°C

What are new equilibrium concentrations of all species if 1 mole of each of CH_3CH_2OH and CH_3COOH are added to this equilibrium mixture? (Apply Le-Chateller's Principle) (Temperature remained same) MDCAT (2017)

A. $(CH_3COOH) = 0.333mol$ $(CH_3COOC_2H_5) = 1.666mol$
$(C_2H_5OH) = 1.333mol$ $(H_2O) = 0.666mol$

B. $(CH_3COOH) = 1.333mol$ $(CH_3COOC_2H_5) = 0.666mol$
$(C_2H_5OH) = 0.333mol$ $(H_2O) = 1.666mol$

[✓ C.] $(CH_3COOH) = 0.666mol$ $(CH_3COOC_2H_5) = 1.333mol$
$(C_2H_5OH) = 0.666mol$ $(H_2O) = 1.333mol$

D. $(CH_3COOH) = 0.333mol$ $(CH_3COOC_2H_5) = 1.333mol$
$(C_2H_5OH) = 0.333mol$ $(H_2O) = 1.333mol$

Q.16 $Ca(OH)_2$ is sparingly soluble having solubility product value 6.5×10^{-6}. What will be its solubility MDCAT (2017)

A. 2.75×10^{-2}

[✓ B.] 1.17×10^{-2}

C. 2.75×10^{2}

D. 3.63×10^{3}

Q.17 The product of the concentrations of each ion in saturated solution of a sparingly soluble salt at 298K raised to the power of their relative concentrations is MDCAT (2018)

[✓ A. Ksp]
B. Kb
C. Ka
D. Kw

Q.18 Which of the following factors effect a reversible chemical reaction in accordance with the Le-Chatelier principle?

A. Pressure
B. Temperature
C. Concentration
[✓ D. Pressure, concentration and temperature]

Q.19 Which one of the following factors does not affect the equilibrium position? SET (2019)

[✓ A. Catalyst]
B. Concentration of reactants and product
C. Temperature
D. Pressure

Q.20 The Kc Unit for the reaction $N_{2(g)}+3H_{2(g)}\rightarrow 2NH_{3(g)}$ are NUMS (2019)

A. $mole^{-1}dm^{+6}$
B. $mole^{-2}dm^{+3}$
[✓ C. $mole^{-2}dm^{+6}$]
D. $mole^{-1}dm^{+3}$

Q.21 Which one of the following bases has highest Kb value? NUMS (2019)

A. NH_4OH
[✓ B. $NaOH$]
C. $Ca(OH)_2$
D. CH_3NH_2

Q.22 What is the pH of 0.1M of HCl? SET (2019)

[✓ A. 1]
B. 0.1
C. 0.01
D. –1

Q.23 The Pka values of CH_3COOH is 4.74, the pH of equimolar solution of acetic acid and sodium acetate is: NUMS (2019)

A. 13.0
B. 7.2
C. 4.79
[✓ D. 4.74]

Q.24 Precipitation occurs when the product of ionic concentration is? NUMS (2019)

[✓ A. Greater than Ksp]
B. Less than Ksp
C. Equal to Ksp
D. Equal to unity

Q.25 $K_p = K_c(RT)$ in the equation if $\Delta n < 0$ then: ETEA (2016)

A. $K_p = K_c$
B. $K_p < K_c$
C. $K_p > K_c$
[✓ D. $K_p < 0$]

Q.26 Pka values of some acids are given below choose the weaker acid? ETEA (2016)

A. $HClO_4(-10)$
B. $HBr(-9)$
[✓ C. $H_2SO_4(-3)$]
D. $HCl(-7)$

Q.27 Consider the reversible reaction.

$N_2 + 2NH_3 \rightleftharpoons 2NH_3 + \text{Heat}$

The yield of NH_3 will be maximum at **ETEA (2019)**

A. High temperature and low pressure
B. High temperature and high pressure
C. Low temperature and low pressure
[✓ D. Low temperature and high pressure]

Q.28 Ice and water is in equilibrium with each other. By increasing the pressure the equilibrium will shift in **ETEA (2019)**

[✓ A. Forward]
B. Reverse
C. To all system at equilibrium
D. None of the above

Q.29 For an equilibrium reaction; **MDCAT (2019)**

$2SO_{2(g)} + O_{2(g)} \Leftrightarrow 2SO_{3(g)}$

the forward reaction is exothermic, increase in temperature shifts the equilibrium position towards left because,

A. The concentrations of SO_3, SO_2 and O_2 increase as the temperature increases
[✓ B. The concentrations of SO_2 and O_2 increase and concentration of SO_3 decreases as the temperature increases]
C. The concentrations of SO_2 and O_2 decrease and concentration of SO_3 increases as the temperature increases
D. The concentrations of SO_2 and O_2 increase and concentration of SO_3 stays same as the temperature increases

Q.30 Which of the following reaction has greater $K_p$than K_c (K_p> K_B.? **NMDCAT (2020)**

A. $2\,NO + Cl_2 \rightleftharpoons 2\,NOCl$
B. $2\,SO_2 + O_2 \rightleftharpoons 2\,SO_3$
[✓ C. $2\,NOCl \rightleftharpoons 2\,NO + Cl_2$]
D. $N_2 + 3H_2 \rightleftharpoons 2\,NH_3$

Q.31 The equation $N_{2g} + 3H_{2g} \rightleftharpoons 2NH_{3g}$ represents: **NMDCAT (2020)**

A. Contact process
[✓ B. Haber's process]
C. Solvay process
D. Avogadro's law

Q.32 For a gaseous phase reaction, when number of moles of reactants and products are equal: **NMDCAT (2020)**

A. The values of $K_n$and K_c are different
B. The value of K_p is greater that K_c
C. The value of K_c is greater that K_c
[✓ D. The value of K_p and K_c are the same]

Q.33 Purification of table salt (NaCl) by passing HCl gas through its saturated aqueous solution is an example of **NMDCAT (2020)**

A. Law of mass action
B. Hess's law
[✓ C. Common ion effect]
D. Henry's law

ANSWER KEY

1	A	11	A	21	A	31	C
2	C	12	B	22	D	32	D
3	B	13	A	23	D	33	B
4	B	14	A	24	B	34	D
5	B	15	A	25	C	35	C
6	D	16	A	26	B		
7	B	17	C	27	C		
8	D	18	C	28	C		
9	A	19	B	29	B		
10	B	20	D	30	B		

PAST PAPER QUESTIONS

1	B	6	D	11	C	16	B	21	B	26	C	31	B
2	D	7	C	12	D	17	A	22	A	27	D	32	D
3	D	8	B	13	B	18	D	23	D	28	A	33	C
4	C	9	B	14	B	19	A	24	A	29	B		
5	C	10	C	15	C	20	C	25	B	30	C		

EXPLANATORY NOTES

Q.1 At dynamic equilibrium

(i) Rate of forward reaction (R_f) = Rate of backward reaction (Rc.

(ii) Concentration of reactant and product becomes constants

It means at equilibrium, concentration of reactant and product does not change with time no matter how much long reaction proceed

Q.2 In dynamic equilibrium, both forward and reverse reaction takes place simultaneously because conditions applied favour both forward and reverse reaction

Q.3

$$\Delta n = n_P - n_R$$

$$=10-9$$

$$\Delta n = +1$$

for unit of K_c

$$K_c=(\text{conc})^{\Delta n}$$

$$K_c=(\text{conc})^{+1}$$

Q.4 $2HI \rightleftharpoons H_2 + I_2$

$$\begin{array}{ccc} 1 & 0 & 0 \\ 1-\frac{1}{2} & \frac{1}{2} & \frac{1}{2} \end{array}$$

According to statement HI was found to be 50% dissociated.

$$\begin{array}{ccc} 0.50-0.25 & 0.25 & 0.25 \end{array}$$

$$Kc = \frac{[H_2][I_2]}{[HI]^2} = \frac{(0.25)(0.25)}{(0.50)^2}$$

$$\frac{1}{4} = 0.25$$

Q.5 If the Kc value is very high reaction is more favourable in forward direction.

Q.6

$$CH_3COOH + C_2H_5OH \rightleftharpoons CH_3COOC_2H_5 + H_2O$$

$$\begin{array}{ccccc} 1 & 1 & 0 & 0 & t=0 \\ 1-\frac{2}{3} & 1-\frac{2}{3} & \frac{2}{3} & \frac{2}{3} & t=\text{eq.} \\ \frac{1}{3} & \frac{1}{3} & \frac{2}{3} & \frac{2}{3} & \end{array}$$

$$Kc = \frac{[CH_3COOC_2H_5][H_2O]}{[CH_3COOH][C_2H_5OH]}$$

$$Kc = \frac{\left(\frac{2}{3}\right)\left(\frac{2}{3}\right)}{\left(\frac{1}{3}\right)\left(\frac{1}{3}\right)} = 4$$

Q.7

$$Kc=\frac{[SO_3]^2}{[SO_2]^2[O_2]}=\frac{(4)^2}{(2)^2(2)}$$

$$=\frac{16}{8}=2$$

Q.8 Concentration of reactant and product becomes constants
It means at equilibrium, concentration of reactant and product does not change with time no matter how much long reaction proceed

Q.9 If Kc is very small it means forward reaction is just started, products are less stable, reactants are more stable and equilibrium position is shifted towards left side.

Q.10 If volume factor is in denominator of K_c expression, it means mole (volume) of product are more than mole (volume) of reactant. So, less pressure favours the forward reaction because according to Le-Chatelier principle increases in pressure move reaction in direction in which volume is less.

Q.11

$$K_c=\frac{K_f}{K_r}$$

Equilibrium constant (K_B. is ratio of K_f and K_r. its value is only changed by change in temperature. Change in temperature (ΔT) changes both equilibrium constant (K_B. as well as equilibrium state / position (Q_B.

Q.12 $K_p = K_c(RT)^{\Delta n}$, $K_p = K_x(RT/V)^{\Delta n}$, $K_p = K_n\left(\frac{P}{N}\right)^{\Delta n}$

Q.13

If $\Delta n = +Ve$ then $K_p > K_c$

If $\Delta n = -Ve$ then $K_p < K_c$

If $\Delta n = 0$ then $K_p = K_c$

and

$$\Delta n = n_P - n_R$$

for $PCl_5 \rightleftharpoons PCl_3 + Cl_2$

$$\Delta n = 2-1$$

$$\Delta n = 1$$

Because Δn is +Ve so $K_p > K_c$

Q.14

$$K_c=\frac{[HI]^2}{[H_2][I_2]}=\frac{(24)^2}{(8)(3)}$$

$$=\frac{24\times 24}{24}=24$$

Q.15

$$\Delta n = n_P - n_R$$

$$= 1 - \frac{3}{2}$$

$$= -\frac{1}{2}$$

$$K_p = K_c(RT)^{\Delta n}$$

$$K_p = K_c(RT)^{-\frac{1}{2}}$$

$$K_p = \frac{K_c}{(RT)^{\frac{1}{2}}}$$

$$(RT)^{\frac{1}{2}} = \frac{K_c}{K_p}$$

Q.16

$A_{2(g)} + 4B_{2(g)} \rightleftharpoons 2AB_{4(g)}$ $\quad \Delta H = -Ve$

5mole 2mole

5 volume 2 volume

According to Le-Chatelier principle, for exothermic reaction

$$\text{Yield} \propto \frac{1}{\text{Temperature}}$$

And increase in pressure move reaction in direction in which volume in less. Because reactant have more volume than product so increase in pressure favours forward reaction

Q.17

According to Le-Chatelier principle, for exothermic reaction

$$\text{Yield} \propto \frac{1}{\text{Temperature}}$$

Q.18

Ice $\rightleftharpoons$ liquid water

According to Le-Chatelier principle, increase in pressure move reaction in direction in which volume is less. Ice has 9% more volume than liquid water. So, increase in pressure will convert ice (more volume) into liquid water (less volume). So, by increasing pressure ice starts to melt.

Q.19 For exothermic reaction

$$\text{Yield} \propto \frac{1}{\text{Temperature}}$$

If temperature is increased, then yield of product become less. It means reaction move in reverse direction

Q.20 The equilibrium mixture has 35% by volume of NH_3.

- Nearly 13% of all nitrogen fixation on earth is accomplished through Haber's process.
- About 80% of NH_3 is used for the production of fertilizers.

Q.21 Optimum conditions for the reasonable yield of ammonia:

(i) Temperature around 673K (400°B.

(ii) Pressure about 200-300atm.

(iii) Pieces of iron crystals embedded in fused mixture of MgO, Al_2O_3 and SiO_2.

Q.22 Basic buffer is the mixture of weak base and salt of it with strong acid. NH_4OH is weak base and NH_4Cl is salt of strong acid (HCl).

Q.23 There is no role of solubility product in buffer action.

Q.24 NH_4OH is weak base and NH_4Cl is salt of strong acid (HCl). It is an example of basic buffer.

Q.25 If the pH of buffer is 7 then it is called neutral buffer which is ideal.

Q.26

$$pKa = -\log K_a$$
$$pKa = -\log 10^{-8}$$
$$pKa = 8\log 10$$
$$= 8(1) = 8$$
$$pH = pKa + \log\left[\frac{Salt}{Acid}\right]$$
$$pH = 8 + \log\frac{1}{1}$$
$$pH = 8 + 0 = 8$$

If concentration of salt and acid is equal, then buffer solution has pH = pKa. Such buffer is called best buffer

Q.27 The Henderson equation can be written as given below:

$$pH = pKa + \log\frac{[salt]}{[acid]}$$
$$pH = pKa - \log\frac{[acid]}{[salt]}$$
$$Pka = pH - \log\frac{[salt]}{[acid]}$$

Q.28 For acidic buffer pH will be less than pKa, if [salt] < [acid]
pH will be greater than pKa if [salt] > [acid]
pH will be equal to pKa if [salt] = [acid]

Q.29

$$NaCl \rightleftharpoons Na^+ + Cl^-$$
$$HCl \rightleftharpoons H^+ + Cl^-$$

Due to common ion effect solubility of NaCl decreases.

Q.30

$$2AgNO_3 + BaCl_2 \longrightarrow 2AgCl + Ba^{+2} + NO_3^-$$

If $AgNO_3$ is in excess then filterate contains Ba^{+2}, NO_3^- and Ag^+. AgCl formed whites ppt, removed by filteration. $BaCl_2$ is consumed completely as compare to $AgNO_3$

Q.31

$$KClO_3 \rightleftharpoons K^+ + ClO_3^-$$

$$KCl \rightleftharpoons K^+ + Cl^-$$

The solubility of less soluble salt $KClO_3$ in water is suppressed by addition of more soluble salt KCl by common ion effect.

Q.32 According to solubility product

i) If ionic product = K_{sp}, then solution is saturated

ii) If ionic product < K_{sp}, then solution is unsaturated

iii) If ionic product > K_{sp}, then solution is supersaturated

Q.33 The solubility product is applicable for sparingly soluble salt whose concentration is equal to or less than $0.01 mol dm^{-3}$.

Q.34

$$AgCl \rightleftharpoons Ag^+ + Cl^-$$

$$K_{sp} = [Ag^+][Cl^-]$$

$$(1\times10^{-5})\times(1\times10^{-5})$$

$$= 1\times10^{-10}$$

Q.35 $AB_3 \rightleftharpoons A^{+3} + 3\,B^{-1}$

$s \qquad s \qquad 3s$

For a compound having four ions

$$K_{sp} = [A^{+3}].[B^{-1}]^3$$

$$K_{sp} = (s).(3s)^3$$

$$K_{sp} = 27s^4$$

$$s = (K_{sp}/27)^{1/4}$$

EXPLANATORY NOTES

(PAST PAPER QUESTIONS)

Q.1 For unit of Kc. $Kc = (moldm^{-3})^{\Delta n}$

$\Delta n = n_P - n_R$

$=2-2=0$

So for this reaction Kc has no unit.

Q.2 Due to common ion effect, strong electrolyte will suppress the ionization of weak electrolytes solubility decrease and it will precipitate out.

Q.3 In case of exothermic reactions when we decrease temp, then reaction will be favourable toward forward direction and in Haber's process more NH_3 will be formed.

Q.4 Buffer solution resist the change in pH.

Q.5 Acid gives proton "H^+" in water

Q.6 pH of human blood is 7.35– 7.40

Q.7 $Kp = Kc\,(RT)^{\Delta n}$

$$2HF \rightleftharpoons H_2 + F_2$$

For given reaction $\Delta n = 0$

So, $Kp = Kc\,(RT)^{0}$

$Kp = Kc$, So, $Kp = 10^{-13}$

Q.8

$$NaOH \longrightarrow Na^{+} + OH^{-1}$$

$$10^{-3}M \longrightarrow 10^{-3}M$$

$$pOH = -\log\left[OH^{-}\right]$$

$$= -(-3)(-\log 10)$$

$$pOH = (+3)(1) = 3$$

$$pH + pOH = 14$$

$$pH = 14 - pOH$$

$$= 14 - 3 = 11$$

Q.9 $2NO_{(g)} + O_{2(g)} \rightleftharpoons 2NO_{2(g)} \quad \Delta H = -114 kJ/mol$

Because reaction is exothermic so it must be carried out at law temperature

Q.10

$$pH = pKa + \log\frac{[salt]}{[Acid]} \quad \text{or} \quad pH = PKa + \log\frac{[Base]}{[Acid]}$$

$$pH = pKa - \log\frac{[Acid]}{[Salt]} \quad \text{or} \quad pH = pKa - \log\frac{[Acid]}{[Base]}$$

Q.11 $Ksp = [cation]^x[Anion]^y \quad for \quad AgCl \rightleftharpoons Ag^{+1} + Cl^{-1}$

so, $Ksp = \left[Ag^{+1}\right]\left[Cl^{-1}\right]$

Q.12 pH of Human blood is 7.35–7.40

Q.13 Ksp value of $BaSO_4$ at 25°C is $1.6\times10^{-8}\ mol^2dm^{-6}$

Q.14 Unit of Kc = $(moldm^{-3})^{\Delta n}$

a.	$N_2+3H_2 \rightleftharpoons 2NH_3$	$Kc=\left(moldm^{-3}\right)^{-2}$	$mol^{-2}dm^{+6}$
b.	$CO+H_2O \rightleftharpoons CO_2+H_2$	$Kc=\left(moldm^{-3}\right)^{o}$	No.Unit.
c.	$SO_2+2O_2 \rightleftharpoons 2SO_3$	$Kc=\left(moldm^{-3}\right)^{-1}$	$mol^{-1}dm^{+3}$
d.	$2NO_2+O_2 \rightleftharpoons 2NO$	$Kc=-\left(moldm^{-3}\right)^{-1}$	$mol^{-1}dm^{+3}$

Q.15 As the Kc value is constant so, by doubling the concentration it will remain same and concentration of all reactants and products will also be doubled.

Q.16 For AB2 type salt we use ksp = $4s^3$ formula

$Ca(OH)_2 \rightleftharpoons Ca^{2+}_{(aq)} + 2OH^-_{(aq)}$

$Ca(OH)_2 \rightleftharpoons 0 \quad + \quad 0$ Initial stage

$Ca(OH)_2 \rightleftharpoons S \quad + \quad 2S$ Equilibrium stage

The $K_{sp} = 6.5\times10^{-6}$

The concentration of OH^- is double the concentration of Ca^{2+}, So

$$K_{sp} = [Ca^{2+}][OH^-]^2 = S \times (2S)^2$$

$$4S^3 = 6.5\times10^{-6}$$

So,
$$S=\left(\frac{6.5\times10^{-6}}{4}\right)=\left(1.625\times10^{-6}\right)^{1/3}$$

$$S = (1.625)^{1/3} \times 10^{-2}$$

$$S = 1.175 \times 10^{-2}$$

Q.17 Solubility product is defined as the product of concentration of each ion in saturated solution of a sparingly soluble salt at 25°C or 298K raised to power of their relative concentration.

Q.18 Factors which effect reversible chemical reaction are conc. pressure, volume and temperature.

Q.19 Catalyst does not effect the equilibrium position It just increase the rate of reaction

Q.20 Unit of Kc for Haber's process is

$$N_2+3H_2 \rightleftharpoons 2NH_3$$

$$Kc=\left(mol\,dm^{-3}\right)^{\Delta n}=?$$

$$=\left(moldm^{-3}\right)^{-2}=mol^{-2}dm^{+6}$$

Q.21 Kb $\propto$ basic strength
NaOH is a very strong base, so it will have highest Kb value

Q.22

$$1HCl \rightleftharpoons 1H^{+} + Cl^{-1}$$

$$0.1mole \qquad 0.1mole$$

$$\begin{aligned} pH &= -\log\left[H^{+}\right] \\ &= -\log\left(10^{-1}\right) \\ &= -(-1)\log 10 \\ &= +1(1) = 1 \end{aligned}$$

Q.23 $pH = pKa + \log\frac{[salt]}{[Acid]}$

When salt and acid have equal concentration then
Log1=0, So,
pH = PKa
PKa of CH_3COOH is 4.74, So, pH will be 4.74

Q.24 When Ksp < Ionic product then Precipitation formed Ksp . Ionic product mean unsaturated solution Ksp = ionic product saturated solution.

$Kp = Kc \qquad \Delta n = 0$

Q.25 $Kp < Kc \qquad \Delta n < 0 \text{ or } \qquad \Delta n = -ive$

$Kp < Kc \qquad \Delta n > 0 \text{ or } \qquad \Delta n = +ive$

Q.26 Pka inversely related to acid strength pka value of $H_2SO_4 > HCl > HBr > HClO_4$
So, weakest acid is H_2SO_4 and strongest and acid is $HClO_4$

Q.27 Haber's process is an exothermic process $N_2 + 3H_2 \rightleftharpoons 2NH_3$ so, low temperature is favourable for towards forward direction.

Q.28 $Ice \rightleftharpoons water$

Ice occupy 9% more space than water, at high pressure empty space will decrease and reaction will move towards forward direction. At high pressure more water will form.

Q.29 $2SO_2 + O_2 \rightleftharpoons 2SO_3 + Heat$

Reaction is exothermic so, at high temperature reaction will move towards backwards direction. Which mean, the concentration of SO_2 and O_2 will increase and SO_3 will decrease.

Q.30 When number of moles of product are greater than number of moles of reactant then Kp > Kc

$\Delta n = +ve \text{ or } \Delta n > 0 \qquad Kp > Kc$

$\Delta n = -ve \text{ or } \Delta n < 0 \qquad Kp < Kc$

$\Delta n = 0 \Rightarrow Kp = Kc$

Q.31 $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$ is representation of Haber's process

Q.32 When $n_P = n_R$ then $\Delta n = 0$ then Kp and Kc will have same value

Q.33 NaCl will precipitate out due to common ion effect.

Topic

7

REACTION KINETICS

PRACTICE EXERCISE

Q.1 **Which one of the following is correct about following reaction if iron is not 100% pure**

$2Fe+3H_2O+O_2 \longrightarrow Fe_2O_3.3H_2O$

A. Very fast reaction

[✓ B. Very slow reaction]

C. Moderately reaction

D. Not predicted

Q.2 **Which of the following reactions are usually slow?**

A. Neutralization of acids and bases

B. Explosive reaction of O_2 and H_2

[✓ C. Organic substitution reaction]

D. Photochemical reactions

Q.3 **For a chemical reaction to occur**

A. The vessel shall be open

B. Reacting molecules should have less energy than Ea at time of collision

[✓ C. Reacting molecules must be properly oriented and energy more than or equal to Ea]

D. The reacting molecules must not collide with each other

Q.4 **The increase in reaction rate as a result of increase in temperature from 10K to 100K is**

[✓ A. 512]

B. 614

C. 400

D. 112

Q.5 **By increasing the concentration of reactants, the rate of reaction________**

A. Decreases

[✓ B. Increases]

C. Remains constant

D. Not predicted

Q.6 **Select the correct rate law from given data**

[A] moles dm^{-3}	[B] moles dm^{-3}	Rate of reaction (moles dm^{-3} sec^{-1})
0.1	0.1	2×10^{-5}
0.2	0.1	4×10^{-5}
0.1	0.2	4×10^{-5}
0.2	0.2	8×10^{-5}

[✓ A. Rate = $k[A][B]$]

B. Rate = $k[A]^2[B]$

C. Rate = $k[A]^\circ[B]^2$

D. Rate = $k[A][B]^2$

Q.7 **The rate of reaction involving ions can be studied by**

A. Spectrometric method

B. Dilatometric method

C. Optical rotation method

[✓ D. Electrical conductivity method]

Q.8 **Which method for rate determination is useful for those reaction, which involve small volume change in solutions**

A. Refractometric method

[✓ B. Dilatometric method]

C. Optical rotation method

D. Spectrometric method

Q.9 **Which method for rate determination is applicable to reactions in solutions, where there are changes in refractive indexes of the substance taking part in the chemical reaction**

A. Dilatometric method

B. Optical rotation method

[✓ C. Refractometric method]

D. Spectrometric method

Q.10 **The specific rate constant of a chemical reaction is the rate of the reaction when the concentration of the reactant is**

A. Less than unity

B. Greater than unity

[✓ C. Equal to unity]

D. Equal to the concentration of 2nd order reaction

Q.11 The unit of rate constant of second order reaction is
A. mol dm^{-3} sec^{-1}
B. sec^{-1}
C. mol^{-2} dm^{+6}
[✓ D. $mole^{-1}$ dm^{+3} sec^{-1}]

Q.12 The 2nd order reaction becomes 1st order when
A. One of the reactants is limiting
[✓ B. One of the reactants is in large excess]
C. None of the reactants is in large excess
D. Both reactants in large excess

Q.13 The half-life time for a 1st order decomposition of a substance dissolved in CCl_4 is 2.5 hours at 30°C. The amount of substance left after 10 hours if the initial weight of the substance is 160g
A. 5g
[✓ B. 10g]
C. 15g
D. 20g

Q.14 Hydrolysis of ethyl acetate into acetic acid and ethanol in the presence of mineral acid is
A. Fractional order reaction
[✓ B. Pseudo 1st order reaction]
C. 1st order reaction
D. 2nd order reaction

Q.15 For a reaction $A + 2B \longrightarrow C$, rate is given by $Rate = k[A][B]$, hence the order of the reaction is
A. 3
[✓ B. 2]
C. 1
D. 0

Q.16 For a chemical reaction $A \longrightarrow B$, the rate of reaction doubles when the concentration of A is increased four times. The order of reaction for A is
A. Zero
B. One
C. Two
[✓ D. Half]

Q.17 What will be order of reaction if doubling the concentration of reactant increases the rate by factor 4 and tripling the concentration of reactant by a factor of 9
A. 1
[✓ B. 2]
C. 3
D. 0

Q.18 When the concentration of reactant in the reaction is increased by 8 times, the rate increased only by 2 times. The order of reaction is
A. 1
[✓ B. $\frac{1}{3}$]
C. $\frac{1}{2}$
D. 2

Q.19 The rate law of a reaction is, rate $=k[A]^2[B]$. On doubling the concentration of both A and B, the rate of reaction increases ______ time
A. 4
B. 9
[✓ C. 8]
D. 2

Q.20 For the reaction $A + B \longrightarrow C + D$, doubling the concentration of both the reactants increases the reaction rate by 8 times and doubling the initial concentration of only B simply doubles the reaction rate. The rate law for the reaction is
A. $Rate = k[A][B]^2$
B. $Rate = k[A][B]$
C. $R = k[A]^{1/2}[B]^2$
[✓ D. $Rate = k[A]^2[B]$]

Q.21 **The rate of reaction $2X + Y \longrightarrow$ Products. Rate $= k[X]^2[Y]$ of X in large excess, the order of reaction is**
A. 3rd
B. 2nd
[✓ C. 1st]
D. 0th

Q.22 **For the 1st order decomposition reaction $2N_2O_{5(g)} \rightarrow 2N_2O_{4(g)} + O_{2(g)}$ the half-life is given as**
[✓ A. 0.693/k]
B. 0.693/2k
C. log2/k
D. ln2/k

Q.23 **The half-life period of zero order reaction is equal to**
A. $\frac{0.693}{K}$
B. $\frac{a}{2K}$
[✓ C. $\frac{1}{Ka}$]
D. $\frac{1.5}{Ka^2}$

Q.24 **For which of the reaction, half-life is inversely proportional to the initial concentration of the reactants**
A. Zero order
[✓ B. 1st order]
C. 2nd order
D. 3rd order

Q.25 **If 'a' is the initial concentration of the reactant then half-life period of the reaction of nth order is directly proportional to**
A. a^{n+1}
B. a^{1-n}
[✓ C. a^n]
D. a^{n-1}

Q.26 **For the first order reaction, half-life is 14 sec. The time requires for the initial concentration to reduce to $\frac{1}{8}$th of its value is**
A. 28s
[✓ B. 42s]
C. $(14)^2$ s
D. $(14)^3$ s

Q.27 **The rate constant of reaction is 3×10^{-3} moldm^{-3}sec^{-1}. The order of reaction is**
A. 1
B. 2
C. 3
[✓ D. 0]

Q.28 **Activation energy of a reaction**
A. Includes the average kinetic energy of the reactants
B. Is in addition to the average K.E. of the reactants
C. Is in addition to the average K.E. of the products
[✓ D. Required for effective collisions]

Q.29 **E_a appears as a potential energy hill between _____ for carrying out the reaction**
A. Among the reactants
B. Among the products
[✓ C. Reactants and the products]
D. None of the above

Q.30 **If E_f and E_r are activation energies of forward and reverse reaction. The reaction is known to be exothermic then**
A. $E_f > E_r$
B. $E_f >>> E_r$
[✓ C. $E_f < E_r$]
D. $E_f = E_r$

Q.31 **For an endothermic reaction $A \longrightarrow B$, an activation energy of forward reaction is 15 kcal mol^{-1} and enthalpy change of reaction is 5 kcal mol^{-1}. The activation energy for reverse reaction $B \longrightarrow A$ is**
[✓ A. 10 kcal mol^{-1}]
B. 20 kcal mol^{-1}
C. 15 kcal mol^{-1}
D. Zero

Q.32 Which one is the assumption of collision theory of reaction rate

A. During a chemical reaction the particles must collide

B. Reaction between the colliding particles can only take place if upon collision they possess the activation energy

C. Only those collisions are effective which take place in proper orientation

[✓ D. All statements are correct]

Q.33 If the energy of the activated complex lies close to energy of reactants, it means that reaction is

A. Slow B. Exothermic

C. Endothermic [✓ D. Exothermic and fast]

Q.34 The activation energy for a simple chemical reaction $A \longrightarrow B$ is E_a in forward direction. The activation energy for reverse reaction

[✓ A. Can be less than or more than E_a] B. Is always double of E_a

C. Is negative of E_a D. Is always less than E_a

Q.35 When potential energy of the transition state is very high, then which one of the following results is applicable?

A. Low activation energy and fast reaction B. Low activation energy and slow reaction

C. High activation energy and fast reaction [✓ D. High activation energy and slow reaction]

Q.36 Which of the following best explains the effects of a catalyst on the rate of a reversible reaction?

A. It decreases the rate of the reverse reaction

B. It increases the kinetic energy of the reacting mole molecules

C. It moves the equilibrium position to the right

[✓ D. It provides a new reaction path with a lower activation energy]

Q.37 What is the correct relation between rate and activation energy

A. Rate $\propto$ Ea B. Rate = Ea

[✓ C. Rate $\propto \frac{1}{Ea}$] D. All of them

Q.38 Concentrated sugar solution under goes hydrolysis into glucose and fructose by an enzyme________

A. Zymase [✓ B. Invertase]

C. Maltase D. None of these

Q.39 Which of the followings is correct about enzyme catalysts

A. These are in pure crystalline state

B. The activity of enzyme catalyst is inhibited by poison

C. Enzyme Catalytic reaction have maximum rate at optimum temperature

[✓ D. All of these]

Q.40 The reaction rate in forward direction decreases with the passage of time because

[✓ A. Concentration of reactants decreases] B. The order of reaction changes

C. Concentration of product decreases D. Temperature of the system changes

PAST PAPER QUESTIONS

Q.1 In some reactions a product formed acts as a catalyst. This phenomenon is called MDCAT (2012)

A. Negative catalysis B. Heterogeneous catalysis
C. Activation of catalyst ●. Autocatalysis

Q.2 The reaction rate in forward direction decreases with the passage of time because MDCAT (2012)

●. Concentration of reactants decreases B. The order of reaction changes
C. Concentration of product decreases D. Temperature of the system changes

Q.3 For the reaction $2NO + O_2 \rightleftharpoons 2NO_2$, the rate equation for the forward reaction is MDCAT (2014)

A. Rate = k $[NO][O_2]$ B. Rate = k $[NO_2]^2$
●. Rate = k $[NO]^2[O_2]$ D. Rate = k $[NO_2]$

Q.4 Choose the type of catalysis in the following reaction MDCAT (2017)

$$2SO_{2(g)} \overset{NO_{(g)}}{\rightleftharpoons} 2SO_{3(g)}$$

●. Homogeneous catalysis B. Biological catalysis
C. Heterogeneous catalysis D. Gas catalysis

Q.5 What is the measure of activation energy in an endothermic reaction? MDCAT (2019)

●. The energy of activation of backward reaction is less than that of forward reaction.
B. The energy of activation of forward-backward reaction is same.
C. The energy of activation of backward reaction is more than that of forward reaction.
D. The energy of activation of forward reaction is less than that of backward reaction.

Q.6 If energy of activated complex is close to energy of reactants, it means that the reaction is NUMS (2019)

●. Fast B. Moderate
C. Slow D. Very slow

Q.7 According to the collision theory of bimolecular reactions in gas phase, minimum amount of energy required for an effective collision is known as MDCAT (2011)

A. Heat of reaction B. Rate of reaction
C. Has no effect on the reaction ●. Energy of activation

Q.8 If the energy of activation of a chemical reaction is very low, the rate of that chemical reaction is observed to be very high because? MDCAT (2019)

A. Concentration of the reactants becomes irrelevant
●. Number of efficient or fruit collisions increase
C. Reaction proceeds without any transition state
D. Molecules of the reactants move slowly

Q.9 The influence of temperature on reaction rate is predicted by NUMS (2019)

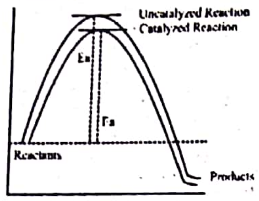
A. Free energy charge B. Wander Waal's equation
●. Arrhenius equation D. Kinetic equation

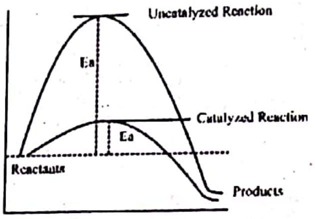
Q.10 For which change of temperature, the rate of reaction become approximately double SET (2019)

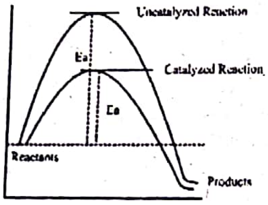
A. 293K B. 283K
C. 20°C ●.10°C

Q.11 **It is experimentally found that catalyst is used to** (MDCAT 2011)
[✓ A.] Lower the activation energy
B. Increase the activation energy
C. Lower the pH
D. Decrease the temperature of other reactants

Q.12 **Which one of the following graphs is representation for more rapid catalyzed reaction?** MDCAT (2017)

A.


[✓ B.]


C.


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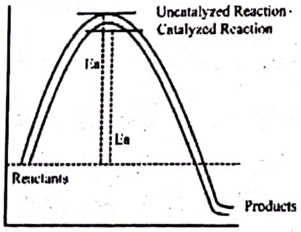


Q.13 **Role of a catalyst in a chemical reaction is to** MDCAT (2018)
[✓ A.] Increase rate of a reaction
B. Decrease rate of a reaction
C. Decrease yield of a reaction
D. Increase yield of product

Q.14 **Glucose is converted into ethanol by the enzyme present in the yeast** MDCAT (2010)
A. Urease
[✓ B.] Zymase
C. Invertase
D. Sucrase

Q.15 **In zero order reaction, the rate is independent of** MDCAT (2013)
A. Concentration of the product
[✓ B.] Concentration of the reactant
C. Temperature of the reaction
D. Surface area of the product

Q.16 **$2A + B \rightarrow$ Product**
If the reactant 'B' is in excess, the order of reaction with respect to 'A' in given rate law Rate = $k[A]^2[B]$ is MDCAT (2016)
[✓ A.] 2nd order reaction
B. Pseudo 1st order reaction
C. 1st order reaction
D. 3rd order reaction

Q.17 **The rate constant 'k' is 0.693 min^{-1}. The half-life for the 1st order reaction will be** MDCAT (2016)
[✓ A.] 1 min
B. 0.693 min
C. 2 min
D. 4 min

Q.18 **Unit of K in first order Reaction is** MDCAT (2017)
[✓ A.] s^{-1}
B. moles dm^{-3}
C. moles $dm^{-3}\ s^{-1}$
D. $mol^{-1}\ dm^3$

Q.19 **Rate of first order reaction depends on** MDCAT (2017)
[✓ A.] Concentration of one reactant
B. Concentration of two reactants
C. Concentration of three reactants
D. Independence of the initial concentration

Q.20 **The unit of rate constant is same as that of rate of reaction in** NUMS (2019)
A. First order reaction
[✓ B.] Zero order reaction
C. Second order reaction
D. Third order reaction

Q.21 **The decomposition of phosphorus pentachloride in the presence of moisture takes place by the following mechanism** **MDCAT (2019)**

$$PCl_{5\,(s)} + H_2O_{(l)} \rightarrow POCl_{3\,(l)} + 2HCl_{(aq)} \quad \text{(Slow Step)}$$
$$POCl_{3\,(l)} + 3H_2O_{(l)} \rightarrow H_3PO_{4\,(l)} + 3HCl_{(aq)} \quad \text{(Fast Step)}$$

$$PCl_{5\,(s)} + 4H_2O_{(l)} \rightarrow H_3PO_{4\,(l)} + 5HCl_{(aq)}$$

The rate equation for this reaction will be:

A. $Rate=k[PCl_5][H_2O]^4$

B. $Rate=[PCl_5][H_2O]$

[✓ C]. $Rate=k[PCl_5][H_2O]$

D. $Rate=k[POCl_3][H_2O]^3$

Q.22 **Rates of photo-chemical reactions do not change with the change in concentration of reactants. What is the order of such reactions?** **SET (2019)**

A. Second order reactions

C. First order reactions

B. Pseudo first order reactions

[✓ D]. Zero order reactions

Q.23 **The half-life of N_2O_5 at 45°C is 24 minutes. How long will it take for sample of N_2O_5 to decay to 25% of its original concentration?** **MDCAT (2015)**

A. 24 minutes

B. 120 minutes

C. 72 minutes

[✓ D]. 48 minutes

Q.24 **When the change in concentration is 6×10^{-4} moldm^{-3} and time for that change is 10 seconds, the rate of reaction will be** **MDCAT (2015)**

A. 6×10^{-3} moldm^{-3} sec^{-1}

B. 6×10^{-2} moldm^{-3}sec^{-1}

C. 6×10^{-4} moldm^{-3} sec^{-1}

[✓ D]. 6×10^{-5} moldm^{-3}sec^{-1}

Q.25 **For the first order reaction, half-life is related to the expression $t_{1/2}=0.693/k$** **SET (2019)**

Half- life is the

A. Time taken for the conc. of the product to the increase to half of its original value.

B. Time taken for the concentration of the reactant, to fall to half of its products value.

[✓ C]. Time taken for the concentration of the reactant to fall to half of its original value

D. Time taken for the concentration of the reactant to fall to quarter of its original value

Q.26 **The rate of reaction involving ions can be studied by method** **MDCAT (2010)**

[✓ B]. Electrical conductivity

A. Dilatometric

D. Optical rotation

C. Refractrometric

Q.27 **If the reactants or product of a chemical reaction can absorb ultraviolet, visible or infra-red radiation then the rate of a chemical reaction can best be measured by which one of the following methods?** **MDCAT (2014)**

B. Graphical method

A. Chemical method

D. Differential method

[✓ C]. Spectrometry

Q.28 If concentration time graph of a reactant indicates a constant half-life, then the order reaction with respect the reactant is **MDCAT (2018)**

[✓ A. First order] B. Zero order
C. Second order D. Half order

Q.29 Choose the one which is not the assumption of collision theory of reaction rate: **ETEA (2016)**

A. For chemical reaction to occur molecule / particles must colloids
B. For reacting Particles must possess a certain minimum amount of energy, the Ea
C. Every collision is not productive
[✓ D. For hydrogen molecule formation from atoms require specific orientation]

Q.30 For exothermic reversible reaction activation energy for forward direction depends upon **ETEA (2019)**

A. Temperature C. Nature of reactant
B. Nature of product [✓ D. Both A and B]

Q.31 What is the measure of activation energy is an endothermic reaction?MDCAT (2019)

[✓ A. The energy of activation of backward reaction is less than that of forward reaction.]
B. The energy of activation of forward-backward reaction is same.
C. The energy of activation of backward reaction is more than that of forward reaction.
D. The energy of activation of forward reaction is less than that of backward reaction.

Q.32 The unit of the rate constant is the same as that of the rate of reaction in **NMDCAT (2020)**

[✓ A. Zero order reaction] B. First order reaction
C. Second order reaction D. Third order reaction

Q.33 The study of rates of chemical reactions and the factors that affect the rates of chemical reactions is known as: **NMDCAT (2020)**

A. Thermodynamics B. Stoichiometry
C. Electrochemistry [✓ D. Chemical kinetics]

Q.34 For which reaction $A_{(g)} \rightarrow$ product **NMDCAT (2020)**

When the concentration of $A_{(g)}$ doubles, the rate of reaction increased four folds, which means it is:

A. Negative order of reaction B. 1^{st} order reaction
C. Zero order of reaction [✓ D. 2^{nd} order reaction]

Q.35 For which of the following order of the reaction, rate of reaction is inversely proportional to the concentration reaction? **NMDCAT (2020)**

A. 1^{st} order reaction B. 2^{nd} order reaction
[✓ C. Negative order of reaction] D. Zero order of reaction

ANSWER KEY

1	B	11	D	21	C	31	A
2	C	12	B	22	A	32	D
3	C	13	B	23	C	33	D
4	A	14	B	24	B	34	A
5	B	15	B	25	C	35	D
6	A	16	D	26	B	36	D
7	D	17	B	27	D	37	C
8	B	18	B	28	D	38	B
9	C	19	C	29	C	39	D
10	C	20	D	30	C	40	A

PAST PAPER QUESTIONS

1	D	6	A	11	A	16	A	21	C	26	B	31	A
2	A	7	D	12	B	17	A	22	D	27	C	32	A
3	C	8	B	13	A	18	A	23	D	28	A	33	D
4	A	9	C	14	B	19	A	24	D	29	D	34	D
5	A	10	D	15	B	20	B	25	C	30	D	35	C

Topic 7

EXPLANATORY NOTES

Q.1 It is rusting of iron so it is very slow process

Q.2 Orgnanic subsitution reactions involve covalent bond breaking therefore these are slow reaction for example hydrolysis of ester.

Q.3 The amount of energy required for effective collisions is called activation energy. Which is required for effective collision along with proper orientation.

Q.4 Temperature increases from 10 k to 100 k is 90 k which is 9 interval of 10 k

$$\text{Rate increases} = (2)^{\text{No. of interval of 10k}}$$

$$\text{Rate increases} = (2)^9 = 512$$

Q.5 By increasing the concentration of reactants, number of effective collisions increases so rate of reaction increases

Q.6 Rate is directly proportional to concentration of A and concentration of B so it is 2nd order reaciton

Q.7 The rate of reactions which involve ions is measured by the electrical conductivity method.

Q.8 This method is applicable for the measurement of rate of those reactions which involve small volume change in the solutions.

Q.9 The method is applicable to reactions in solutions where there are changes in refractive indices of the substances taking part in the chemical reactions.

Q.10 The rate of reaction when the concentrations of reactants are unity is called Specific rate constant or velocity constant.

Using equation (1):

Rate of reaction $= k\,[A]^a\,[B]^b$

Suppose [A] $= [B] = 1\,\text{moles/dm}^3$

Rate of reaction $= k\,[1]^a\,[1]^b$

Rate of reaction $= k$ (since, $[1]^a\,[1]^b = 1$)

Q.11 For **second order** reaction, the units of rate constants k are given by:

Units of $k = (\text{concentration})^{1-n}\,(\text{time})^{-1}$

For second order $n = 2$

Units of $k = (\text{mole/dm}^3)^{1-2}\,(\text{s})^{-1}$

Units of $k = (\text{mole/dm}^3)^{-1}\,\text{s}^{-1}$

Units of $k = \text{moles}^{-1}\,\text{dm}^3\,\text{s}^{-1}$

Units of $k = \text{dm}^3\,\text{moles}^{-1}\,\text{s}^{-1}$

Q.12 The substance taken in small amount controls the rate and the order is noted with respect to that substance. If the conc. Of any reactant is taken in excess it will not involve in rate determination step

Q.13
$$\text{Number of half-life} = \frac{\text{Total time}}{\text{Half-life}}$$

$$\frac{10}{2.5} = 4$$

$$160g \rightarrow 80g \rightarrow 40g \rightarrow 20g \rightarrow 10g$$

After 4 half-life 10g left behind

Q.14 In hydrolysis of ester water is in large excess therefore it is pseudo 1st order reaciton

Q.15 $Rate = k[A][B]$ the sum of the exponents of concentration terms in given rate law equation is two

Q.16

$$Rate = [A]^n$$

$$2 = [4]^n, 2 = 2^{2n}, 1 = 2n, \ n = \frac{1}{2}$$

Q.17 For 2nd order reaction

$$Rate = k[A]^2$$

$$Rate = k[2]^2 = 4$$

$$Rate = k[3]^2 = 9$$

Q.18

$$Rate = [A]^n$$

$$2 = [8]^n, 2 = 2^{3n}, 1 = 3n, \ n = \frac{1}{3}$$

Q.19

$$Rate = k[A]^2[B]$$

$$Rate = (2)^2(2), = 4 \times 2 = 8$$

Q.20 It is overall 3rd order reaction. With respect to A, it is 2nd order reaction with respect to B is 1st order

Q.21 X is large excess, so rate of reaction is independent to the concentration of X and is directly proportional to the concentration of Y. It is 1st order reaciton with respect to Y.

Q.22 $\left[t_{1/2}\right]_1 = \frac{0.693}{k}$

Q.23 For zero order reaction half-life period is directly proportional to the initial concentration of reactant

Q.24

$$\left[t_{1/2}\right]_n \propto \frac{1}{a^{n-1}}$$

$$\left[t_{1/2}\right]_2 \propto \frac{1}{a^{2-1}}$$

$$\left[t_{1/2}\right]_2 \propto \frac{1}{a}$$

Q.25

$$\left[t_{1/2}\right]_n \propto \frac{1}{a^{n-1}}$$

$$\left[t_{1/2}\right]_n \propto a^{-(n-1)}$$

$$\left[t_{1/2}\right]_n \propto a^{1-n}$$

Q.26 After three half-life concentraiton of reactant is reduced to $\frac{1}{8}$th

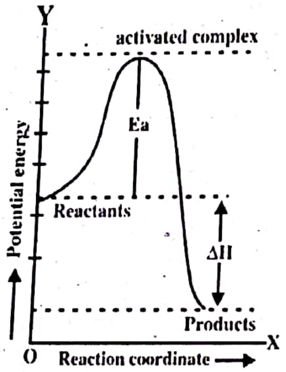
Total time = half-life × Number of half-life
= 14sec × 3 = 42 sec

Q.27 The unit of rate constant in given statement is $\text{moldm}^{-3}\text{sec}^{-1}$ which shows it is zero order reaction. $K = (\text{moldm}^3)^{1-n}\ s^{-1}$

Q.28 The minimum amount of energy required by the colliding molecules for effective collision is called activation energy.

Q.29 Potential of activated complex (EA. is higher than that of reactant and product

Q.30



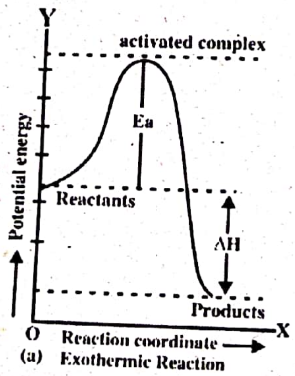
(a) Exothermic Reaction

Q.31

$$Ea_r = Ea_f - \Delta H$$
$$= 15-(+5) = 10$$

Q.32 All the given statements are correct (during a chemical reaction the particles must collide, reaction between the colliding particles can only take place if upon collision they possess the activation energy and only those collisions are effective which take place in proper orientation)

Q.33



(a) Exothermic Reaction

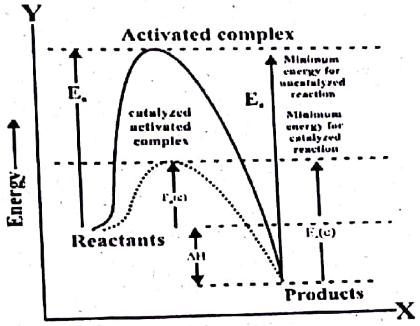
Q.34 (i) For exothermic reaction, energy of activation for forward reaction is less than the energy of activation for backward reaction.

(ii) For endothermic reaction, energy of activation for forward reaction is greater than the energy of activation for backward reaction.

Q.35 Ea ∝ P.E of activated complex

Rate of reaciton $\propto \frac{1}{E_a}$

Q.36


Y
Activated complex
E_a
E_a
Minimum energy for uncatalyzed reaction
catalyzed activated complex
Minimum energy for catalyzed reaction
Energy
$E_a(c)$
$E_a(c)$
Reactants
ΔH
Products
X

Catalyzed and uncatalyzed reaction

Q.37 Rate of reaciton is inversly proportional to the activaiton energy. Lower the activaiton energy reaction will be fast.

Q.38 $C_{12}H_{22}O_{11} + H_2O \xrightarrow{\text{Invertase}} \underset{\text{fructose}}{C_6H_{12}O_6} + \underset{\text{glucose}}{C_6H_{12}O_6}$

Q.39 All are the correct characteristics of enzym catalysts

Q.40 By decreasing the concentration of reactants effective collisions also decreases. Hence rate of rection decreases.

EXPLANATORY NOTES

(PAST PAPER QUESTIONS)

Q.1 If product formed act as catalyst is called auto-catalyst and reaction is called auto-catalysis

Q.2 According to law of mass action, rate of reaction is directly proportional to product of active masses of reactant. During reaction, active masses or concentration of reactant decreases. That is why, rate in forward direction decreases with decrease in concentration of reactants.

Q.3 According to given reaction, reaction is 2nd order with respect to NO and 1st order with respect to O_2. So, overall rate equation is

Rate = $[NO]^2[O_2]$

Q.4 If reactant and catalyst are in same phase then it is called homogeneous catalysis. In given lead chamber process, reactant and catalyst (NO) are in same gaseous phase, so it is homogeneous catalysis.

Q.5 For endothermic reaction, activation energy of forward reaction (E_f) is more than activation energy of reverse reaction (E_r)

Q.6 If energy of activated complex is close to energy of reactants then reaction is fast, spontaneous and exothermic

Q.7 Minimum amount of energy in addition to average kinetic energy is called activation energy OR Minimum amount of energy which must be possessed by reactant to convert into product is called activation energy OR Minimum amount of energy required for an effective collision is called activation energy.

Q.8 Rate of reaction is directly proportional to no. of effective collision and inversely proportional to activation energy. If activation energy is very low then no. of effective collision would increase and rate of reaction would be very high

Q.9 Influence of temperature on reaction rate is predicted by Arrhenius equation. According to Arrhenius equation,

$$\text{Rate} \propto \text{temperature}$$

$$\text{Rate} \propto 1/\text{Ea}$$

Q.10 Rate of reaction become double for every 10 °C / 10 K rise in temperature

Q.11 A positive catalyst increases rate of reaction, decreases activation energy, decreases equilibrium time and changes mechanism of reaction

Q.12 Rate of reaction is inversely proportional to activation energy. Lower the activation energy higher the rate of reaction

Q.13 A positive catalyst increases rate of reaction, decreases activation energy, decreases equilibrium time and changes mechanism of reaction

Q.14 Enzyme which hydrolyse urea into NH_3 and CO_2 is urease, glucose into ethanol is zymase, sucrose into glucose and fructose is invertase

Q.15 In zero order reaction, rate of reaction is directly proportional to zero power of concentration of reactant or rate of reaction is independent of concentration of reactant

Q.16 Experimental rate equation is called rate law. According to rate law equation, order is 2nd with respect to "A" while order is zero with respect to "B". Order of reaction is zero with respect to excess reactant. So, overall order of reaction is 2nd

Q.17 Half life of 1st order reaction is given as

$$(t_{1/2})_1 = 0.693 / k = 0.693 / 0.693 = 1 \text{ min}$$

Q.18 Unit of rate constt. "k" = $(\text{moldm}^{-3})^{1-n}\,\text{s}^{-1}$

Q.19 For 1st order reaction, rate of reaction is directly proportional to first power of concentration of reactant

Q.20 For zero order reaction, rate constt "k" has same unit as rate of reaction. Rate of reaction has unit of $\text{moldm}^{-3}\,\text{s}^{-1}$

Unit of rate constt. "k" = $(\text{moldm}^{-3})^{1-n}\,\text{s}^{-1}$

Q.21 Slow step of reaction is called rate determining step and determine the rate of whole reaction

Q.22 All photochemical reaction has zero order reaction

Q.23 Suppose N_2O_5

$$100g \xrightarrow{t_{\frac{1}{2}}} 50g \xrightarrow{t_{\frac{1}{2}}} 25g$$

$$\text{total time for decay} = \text{No. of } t_{\frac{1}{2}} \times t_{\frac{1}{2}}$$

$$= 2 \times 24$$

$$= 48 \text{ min}$$

Q.24

$$Rate = \frac{\Delta C}{\Delta t} = \frac{6\times10^{-4}}{10}$$

$$= 6\times10^{-5}\, mol\, dm^{-3} s^{-1}$$

Q.25 Half-life is the time in which 50% reactant are converted into product.

Q.26 Reaction which involve ions, their rate of reaction can be measured by electrical conductivity method

Change in electrical conductivity $\propto$ rate of reaction

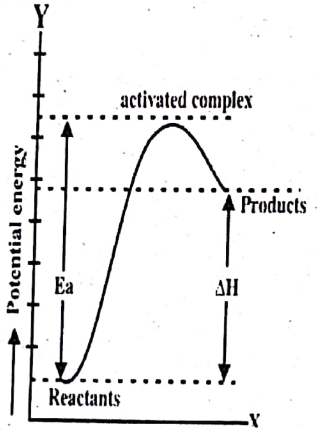
Q.27 If reactant or product absorb UV/Vis, IR radiations, their rate of reaction can be measured by spectrometric method

Q.28 $t_{\frac{1}{2}}$ of 1^{st} order reaction is independent of initial concentration of reactant. So, in concentration time graph, reactant indicates a constant half-life

Q.29 According to collision theory of reaction rate, molecules of all species must collide effectively. For effective collision, molecule must have same orientation and appropriate energy

Q.30 Ea depends on nature of reactant. Elements of group (I, II) and (VI, VII) have low ionization energy and high electron affinity respectively. So, they are known as reactive elements.

Q.31 For endothermic reaction $E_f > E_r$



Q.32 For zero order reaction, rate equation is

$$\text{Rate} = k[A]^\circ$$

$$\text{Rate} = k$$

$$mol\,dm^{-3}s^{-1} = k$$

Hence for zero order reaction, rate constant 'k' has same unit as rate of reaction

Q.33 Reaction kinetics deals with rate of reaction, factor affecting rate of reaction, mechanism of reaction and order of reaction

Q.34

$$Rate = [A]^n$$

$$4 = [2]^n$$

$$2^2 = 2^n$$

If bases are same then exponent are also equal, so n = 2

Q.35

$$\left(t_{\frac{1}{2}}\right)_n \propto \frac{1}{a^{n-1}} \propto a^{1-n}$$

for 2nd order reaction

$$\left(t_{\frac{1}{2}}\right)_2 \propto \frac{1}{a}$$

Topic 8

THERMOCHEMISTRY AND ENERGETICS OF CHEMICAL REACTIONS

PRACTICE EXERCISE

Q.1 Thermodynamics does NOT deal with

A. Heat of reaction
B. Spontaneity of reaction
[✓ C. Rate of reaction]
D. Entropy of reaction

Q.2 If an endothermic reaction is allowed to take place very rapidly in air, the temperature of the surrounding air will

A. Remains constant
B. Increase
[✓ C. Decrease]
D. Either increase or decrease

Q.3 The exothermic process is

A. Evaporation
B. Sublimation
[✓ C. Respiration]
D. Boiling

Q.4 A process, which take place on its own without any outside assistance, is termed as

A. Isothermal process
[✓ B. Spontaneous]
C. Non-spontaneous
D. Adiabatic process

Q.5 The work done by expansion of gas against constant pressure is

A. PΔV
[✓ B. – PΔV]
C. PV
D. ΔPV

Q.6 A state function which describes together the internal energy and product of pressure and volume is called

[✓ A. Enthalpy]
B. Work
C. Internal energy
D. Kinetic energy

Q.7 The enthalpy of formation of a compound is:

A. Positive
B. Negative
[✓ C. Either positive or negative]
D. None of the above

Q.8 Enthalpy is an expression for the

[✓ A. Heat content]
B. Rate of reaction
C. Internal energy
D. Activation energy

Q.9 Which one of the following has standard enthalpy of formation is zero?

A. $Fe_{(g)}$B. $C_{(l)}$
[✓ C. $Cu_{(s)}$]
D. $Na_{(g)}$

Q.10 Which of the following statement is correct

A. ΔH is positive for exothermic reaction
[✓ C. ΔH is negative for endothermic reactions]
B. The heat of neutralization of strong acid with strong base is always the same
D. The enthalpy of fusion is negative

Q.11 What is not correct about ΔH_f

A. Its value gives an idea about the relative stability of reactants and the products
C. It is always negative
[✓ B. Value depends upon nature of bonds]
D. Its value may be negative or positive

Q.12 Which of the following has positive value of enthalpy

A. Neutralization
B. combustion
[✓ C. Atomization]
D. All of the above

Q.13 $NaOH + HCl \rightarrow NaCl + H_2O$. Enthalpy change in the above reaction is called

A. Enthalpy of reaction
B. Enthalpy of formation
[✓ C. Enthalpy of neutralization]
D. Enthalpy of combustion

Q.14 Enthalpy of neutralization (ΔH°_n) per mole of H_2SO_4 / $Ba(OH)_2$ is

[✓ A. $-57.4\ kJmol^{-1}$]
B. $+57.4\ kJmol^{-1}$
C. $-114.8\ kJmol^{-1}$
D. $114.8 kJmol^{-1}$

Q.15 Which of the following processes has always $\Delta H = -ve$

A. Formation of compound
[✓ B. Combustion]
C. Dissolution of ionic compound
D. Dilution of a solution

Q.16 Heat absorbed or evolved during the chemical reaction at constant pressure is

[✓ A. ΔH]
B. ΔE
C. ΔV
D. $\Delta H + \Delta E$

Q.17 The change in enthalpy of a system when one mole of the substance is completely burnt in excess of air or oxygen is called

A. Heat of reaction
B. Heat of atomization
C. Heat of formation
[✓ D. Heat of combustion]

Q.18 Which of the following enthalpy change may be positive or negative value

A. ΔH_f
B. ΔH_c
C. ΔH_{sol}
[✓ D. Both A and B]

Q.19 Neutralization of acid – base is

A. Spontaneous
B. Exothermic
C. Non spontaneous
[✓ D. Both A. and B.]

Q.20 ΔH° represent the enthalpy change at

A. 0°C and 1 atm pressure
B. 0K and 1 atm pressure
[✓ C. 25°C and 1 atm pressure]
D. 25°C and 2 atm pressure

Q.21 The enthalpy changes ΔH of a process is given by the relation

[✓ A. $\Delta H = \Delta E + P\Delta V$]
B. $\Delta H = \Delta E - \Delta nRT$
C. $\Delta E = \Delta H + \Delta P$
D. $\Delta E = \Delta H + P\Delta V$

Q.22 A system absorbs 100 kJ heat and performs 50 kJ work on the surroundings. The increase in internal energy of the system is

[✓ A. 50 kJ]
B. 100 kJ
C. 150 kJ
D. 5000 kJ

Q.23 Which equation represents the atomization of iodine

A. $\frac{1}{2}I_{2(s)} \longrightarrow I_{(l)}$
[✓ B. $\frac{1}{2}I_{2(s)} \longrightarrow I_{(g)}$]
C. $I_{2(l)} \longrightarrow 2I_{(g)}$
D. $I_{2(g)} \longrightarrow 2I_{(g)}$

Q.24 The ΔH°_f of a reaction is recorded at

A. 273 K
B. 373K
[✓ C. 298K]
D. 473K

Q.25 Which of the following enthalpies is always negative

A. Enthalpy of solution
B. Enthalpy of sublimation
[✓ C. Enthalpy of neutralization]
D. Enthalpy of formation

Q.26 Which one of the following equation shows standard enthalpy of combustion?

[✓ A. $CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(g)}$]
B. $2CH_{4(g)} + 4O_{2(g)} \rightarrow 2CO_{2(g)} + 4H_2O_{(g)}$
C. $CH_{4(s)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(g)}$
D. $CH_{4(l)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(g)}$

Q.27 Enthalpy of a reaction can be measured by

[✓ A. Glass calorimeter]
B. Manometer
C. Barometer
D. Thermometer

Q.28 How much heat is absorbed by 100 g of water when its temperature decreases from 25°C to 5°C? (heat capacity is 4.2 J/gK)

A. 84,000 J
B. – 2000/4.2 J
C. 2000/4.2 J
[✓ D. – 84,00 J]

Q.29 Enthalpy of combustion of food, fuel and other compounds can be measured accurately by
A. Glass calorimeter
[✓ B. Bomb calorimeter]
C. Thermometer
D. Manometer

Q.30 Which enthalpy of reaction can-not be determined by glass calorimeter
A. Enthalpy of formation
B. Enthalpy of neutralization
C. Enthalpy of solution
[✓ D. Enthalpy of combustion]

Q.31 Total heat energy (q) can be calculated in a bomb calorimeter by using following formula
A. m × s
[✓ B. c × ΔT]
C. s × ΔT
D. c × s x ΔT

Q.32 Which one of the following is applied to calculate lattice energy indirectly?
[✓ A. Born-Haber cycle]
B. Bohr theory
C. Le-Chatelier principle
D. All of them

Q.33 In order to determine ΔH_{latt} of ionic compound which is correct relationship
[✓ A. $\Delta H_{latt} = \Delta H_f - \Delta H_x$]
B. $\Delta H_{latt} = \Delta H_f + \Delta H_x$
C. $\Delta H_{latt} = \Delta H_a + \Delta H_v$
D. $\Delta H_{latt} = \Delta H_f - \Delta H_{sol}$

Q.34 Which equation shows lattice energy for ionic compound
A. $Na_{(s)} + \frac{1}{2}Cl_{2(g)} \rightarrow NaCl_{(s)}$
B. $Na^+_{(aq)} + Cl^-_{(aq)} \rightarrow NaCl_{(aq)}$
C. $Na_{(s)} + Cl_{(g)} \rightarrow NaCl_{(s)}$
[✓ D. $Na^+_{(g)} + Cl^-_{(g)} \rightarrow NaCl_{(s)}$]

Q.35 With the increase in charge to size ratio of ions, the lattice energy
A. Remains unaffected
[✓ B. Increases]
C. Decreases
D. All of these are possible

Q.36 Hess's law is analogous to
A. Law of heat summation
B. Law of heat exchange
C. Law of increasing entropy
[✓ D. 1st law of thermodynamics]

Q.37 One of the best applications of Hess's law to calculate the lattice energy of ionic compound is
A. Measurement of enthalpy change in a calorimeter
B. Studying of first law of thermodynamics
[✓ C. Born-Haber cycle]
D. Measurement of a heat of formation of a compound

Q.38 Which of the following enthalpies of formation cannot be measured directly?
A. ΔH^o_{latt} for ionic compound
B. ΔH^o_f for $CO_{(g)}$
C. ΔH^o_f for B_2O_3
[✓ D. All of these]

Q.39 The standard enthalpy changes of formation of carbon dioxide and water are -394 KJmol^{-1} and -286kJ mol^{-1} respectively, if the standard enthalpy change of combustion of propyne, C_3H_4 is -1938 KJ mol^{-1}. What is its standard enthalpy change of formation?
A. +1258 kJ mol^{-1}
B. +180 kJ mol^{-1}
[✓ C. -184 kJ mol^{-1}]
D. -680 kJ mol^{-1}

Q.40 The heat of combustion of ethane (C_2H_6) is –337.0 kcal at 25°C. The heat of the reaction when 3g of ethane is burnt completely is
A. –3.37 kcal
B. +3.37 kcal
[✓ C. –33.7 kcal]
D. 33.7 kcal

PAST PAPER QUESTIONS

Q.1 A spontaneous process is **MDCAT (2010)**
A. Unidirectional and irreversible
B. Unidirectional and real
C. Irreversible and real
[✓ D. All of above]

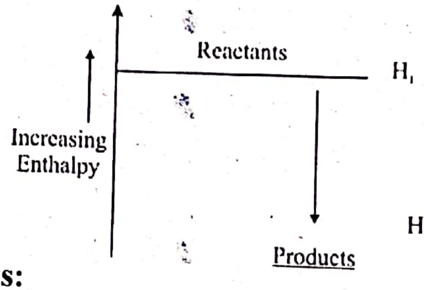
Q.2 ΔH will be given a negative sign in **MDCAT (2012)**
[✓ A. Exothermic reactions]
B. Dissociation reactions
C. Decomposition reactions
D. Endothermic reactions

Q.3 Reactants have high energy than products in **MDCAT (2013)**
A. Endothermic reactions
[✓ B. Exothermic reactions]
C. Photochemical reactions
D. Non-spontaneous reactions

Q.4 Reaction of water with quick lime result in the rise in the temperature of the system. Using the concentration change, indicate the nature of the reaction? **MDCAT (2018)**
A. Third order reaction
B. Endothermic reaction
C. Non spontaneous reaction
[✓ D. Exothermic reaction]

Q.5 Which of the following enthalpy change is always exothermic? **MDCAT (2018)**
A. Enthalpy of solution
B. Enthalpy of formation
[✓ C. Enthalpy of combustion]
D. Enthalpy of atomization

Q.6 The given diagram shows the enthalpy changes during a chemical reaction.
MDCAT (2019)



This diagram represents:
A. An endothermic reaction
[✓ B. An exothermic reaction]
C. A non-spontaneous process
D. An isothermic process

Q.7 Heat of formation of MgO is given below. $Mg + 1/2O_{2(g)} \rightarrow MgO_{(s)}$ $\Delta H = -692$k jmol^{-1} This equation shows that: **SET (2019)**
[✓ A. The product is very stable]
B. The product is highly unstable
C. The reaction is endothermic
D. The reactants are very stable

Q.8 When one mole of gaseous hydrogen ions are dissolved in water to form infinitely dilute solution, amount of heat liberated is **MDCAT (2010)**
[✓ A. -1075kJ/mol]
B. -499kJ/mol
C. -1891kJ/mol
D. -1562kJ/mol

Q.9 In standard enthalpy of atomization heat of surrounding **MDCAT (2011)**
A. Remains same
B. Increases
[✓ C. Decreases]
D. Increases then decreases

Q.10 Heat of formation (ΔH°_{f}) for CO_2 is **MDCAT (2013)**
A. -390 kJ/mole
B. +394 kJ/mole
[✓ C. -394 kJ/mole]
D. -294 kJ/mole

Q.11 $2H_2 + O_2 \longrightarrow 2H_2O$ $\Delta H = 205.5$ kJmol^{-1} what will be the enthalpy change in the above reaction **MDCAT (2014)**
A. 205.5 kJ mol^{-1}
[✓ B. -205.5 kJ mol^{-1}]
C. Zero kJ mol^{-1}
D. 1 kJ mol^{-1}

"Actual value of enthalpy change for given reaction is **-285.8 kJ mol^{-1}**"

Q.12 The equation that represents standard enthalpy of atomization of hydrogen is **MDCAT (2015)**

A. $\frac{1}{2}H_2O_{(\ell)} \longrightarrow H_{2(g)} + \frac{1}{2}O_{(g)}$ +218kJmol^{-1}

B. $\frac{1}{2}H_2O_{(\ell)} \longrightarrow H_{2(g)} + \frac{1}{2}O_{(g)}$ -218kJmol^{-1}

[✓ C. $\frac{1}{2}H_{2(g)} \longrightarrow H_{(g)}$ +218kJmol^{-1}]

D. $\frac{1}{2}H_{2(g)} \longrightarrow H_{(g)}$ -218kJmol^{-1}

Q.13 $\frac{1}{2}H_{2(g)} \longrightarrow H_{(g)}$ $\Delta H = 218KJmol^{-1}$

In this reaction ΔH will be called **MDCAT (2016)**

[✓ A. Enthalpy of atomization] B. Enthalpy of formation

C. Enthalpy of decomposition D. Enthalpy of the dissociation

Q.14 $Mg + \frac{1}{2}O_2 \longrightarrow MgO_{(s)} + -692KJmol^{-1}$ **at STP.** **MDCAT (2016)**

Enthalpy of the above reaction will be called:

A. ΔH°_{at} B. ΔH°_{sol}

C. ΔH°_n [✓ D. ΔH°_f]

Q.15 Determinate the value of Enthalpy of formation of NH₄Cl: **MDCAT (2017)**

A. -788 kJmol^{-1} [✓ B. -692 kJmol^{-1}]

C. -314.55 kJmol^{-1} D. None of these

Q.16 Enthalpy is measured at ____________ **MDCAT (2017)**

A. 300 K and 2 atm [✓ B. 298 K and 1 atm]

C. 300 K and 1 atm D. 295 K and 1 atm

Q.17 Which enthalpy change is relevant in the following process? **MDCAT (2019)**

$Na_{(s)} \rightarrow Na_{(g)}$ $\Delta H = +108kJmol^{-1}$

A. Enthalpy of fusion B. Enthalpy of vaporization

[✓ C. Enthalpy of atomization] D. Enthalpy of formation

Q.18 When two moles of H₂ and one mole of O₂ react to form H₂O 484KJ heat is evolved what is ΔH$_f$ for one mole of H₂O **NUMS (2019)**

A. –484KJmol^{-1} [✓ B. –242KJmol^{-1}]

C. –121KJmol^{-1} D. +242KJmol^{-1}

Q.19 For a given reaction $CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$ the change in enthalpy under standard conditions is called? **SET (2019)**

A. Standard enthalpy change of solution B. Standard enthalpy change of hydration

[✓ C. Standard enthalpy of neutralization] D. Standard enthalpy change of formation

Q.20 Which of the equations shows the same "twice" the enthalpy change of neutralization as the following equation **MDCAT (2019)**

HCl + NaOH → NaCl + H₂O

[✓ A. $H_2SO_4 + Mg(OH)_2 \rightarrow MgSO_4 + 2H_2O$] B. $NH_4Cl + NaOH \rightarrow NaCl + H_2O + NH_3$

C. $MgCO_3 + 2HCl \rightarrow MgCl_2 + CO_2 + H_2O$ D. $KOH + HCl \rightarrow KCl + H_2O$

Q.21 **Lattice energy of an ionic crystal is the enthalpy of:** **MDCAT (2011)**

A. Combustion
B. Dissociation
C. Dissolution
[✓ D. Formation]

Q.22 **Combustion of graphite to form CO_2, can be done by two ways. Reactions are given as follow** **MDCAT (2012)**

$C + O_2 \longrightarrow CO_2$ $\Delta H = -393.7\,kJmol^{-1}$

$C + \frac{1}{2}O_2 \longrightarrow CO$ $\Delta H_1 = ?$

$CO + \frac{1}{2}O_2 \longrightarrow CO_2$ $\Delta H_2 = -283\,kJmol^{-1}$

A. – 676 kJ mol^{-1}
B. + 110 kJ mol^{-1}
[✓ C. – 110 kJ mol^{-1}]
D. 676 kJ mol^{-1}

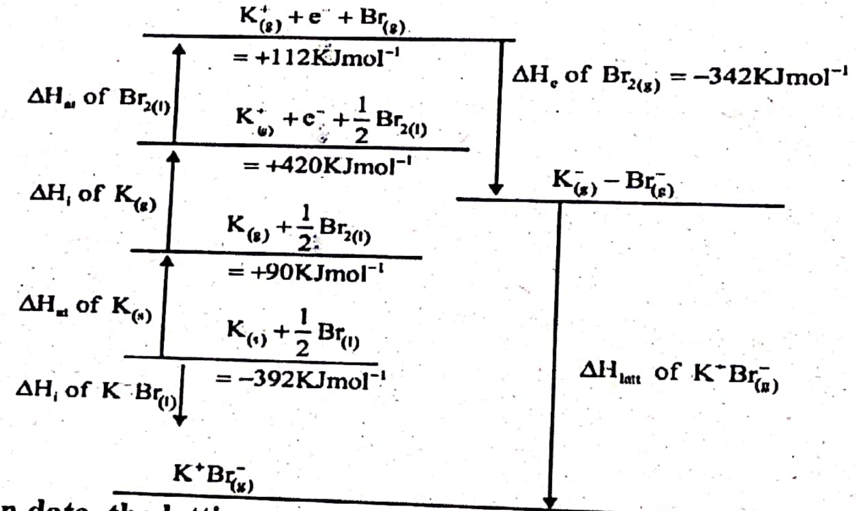
Q.23 **Calculate the lattice energy of sodium chloride on the basis of Born-Haber cycle when** **MDCAT (2017)**

$$\Delta H_f[NaCl] = -411KJmol^{-1},\ \Delta H_{at}[Na] = +107KJmol^{-1},\ \Delta H_{at}[Cl] = +122KJmol^{-1},$$

$$\Delta H_{i1}[Na] = +496KJmol^{-1},\ \Delta H_{eat}[NaCl] = -349KJmol^{-1}$$

A. 376 kJ/mole
B. -376 kJ/mole
C. +787 kJ/mole
[✓ D. -787 kJ/mole]

Q.24 **The given diagram is a Born-Haber cycle for the formation of KBr** **SET (2019)**



$K^+_{(g)} + e^- + Br_{(g)}$
$= +112KJmol^{-1}$
ΔH_{at} of $Br_{2(l)}$
ΔH_e of $Br_{2(g)} = -342KJmol^{-1}$
$K^+_{(g)} + e^- + \frac{1}{2}Br_{2(l)}$
$= +420KJmol^{-1}$
ΔH_i of $K_{(g)}$
$K^-_{(g)} - Br^-_{(g)}$
$K_{(g)} + \frac{1}{2}Br_{2(l)}$
$= +90KJmol^{-1}$
ΔH_{at} of $K_{(s)}$
$K_{(s)} + \frac{1}{2}Br_{(l)}$
$= -392KJmol^{-1}$
ΔH_f of $K^-Br_{(l)}$
ΔH_{latt} of $K^+Br^-_{(g)}$
$K^+Br^-_{(s)}$

Using the given data, the lattice energy of potassium bromide is calculated to be

[✓ A. $-672kJmol^{-1}$]
B. $-672KCalmol^{-1}$
C. $-787\,kJmol^{-1}$
D. $+672\,Jmol^{-1}$

Q.25 **Which one of the following is not a state function?** **ETEA (2019)**

[✓ A. Work]
B. Enthalpy
C. Internal energy
D. Pressure

Q.26 **The thermal energy at constant pressure is called** **NMDCAT (2020)**

[✓ A. Enthalpy]
B. Internal energy
C. Heat capacity
D. Work done

Q.27 **Born-Haber cycle is used to determine the lattice energies of:** **NMDCAT (2020)**

A. Molecular solids
B. Metallic solids
[✓ C. Ionic solids]
D. Covalent solids

Q.28 **One calorie is equal to** **NMDCAT (2020)**

A. 4.18 KJ
[✓ B. 4.18 J]
C. 0.418 KJ mol^{-1}
D. 0.418 KJ

ANSWER KEY

1	C	11	B	21	A	31	B
2	C	12	C	22	A	32	A
3	C	13	C	23	B	33	A
4	B	14	A	24	C	34	D
5	B	15	B	25	C	35	B
6	A	16	A	26	A	36	D
7	C	17	D	27	A	37	C
8	A	18	D	28	D	38	D
9	C	19	D	29	B	39	C
10	C	20	C	30	D	40	C

PAST PAPER QUESTIONS

1	D	6	B	11	B	16	B	21	D	26	A
2	A	7	A	12	C	17	C	22	C	27	C
3	B	8	A	13	A	18	B	23	D	28	B
4	D	9	C	14	D	19	C	24	A		
5	C	10	C	15	B	20	A	25	A		

EXPLANATORY NOTES

Q.1 Thermodynamics is study of heat change during a reaction. It does not deal with rate of reaction.

Q.2 Endothermic reaction absorb heat. Heat is taken from surrounding. So, temperature of surrounding air decreases.

Q.3 Respiration involve exothermic process.

Q.4 A process which take place on its own without any outside assistance, is known as spontaneous process.

Q.5 Work done by the system is considered negative.

Q.6 $H = E + PV$

Q.7 Enthalpy of formation may be negative or positive.

$$Mg_{(s)} + \frac{1}{2}O_2 \longrightarrow MgO_{(s)} \qquad \Delta H^\circ_f = -692 kJ/mol$$

$$\frac{1}{2}N_{2(g)} + O_{2(g)} \longrightarrow NO_{2(g)} \qquad \Delta H^\circ_f = 33.18 kJ/mol$$

Q.8 Total heat content of the system is called enthalpy.

Q.9 Standard enthalpy of an element in its standerd state is zero.

Q.10 Enthalpy of neutralization is merely the heat of formation of liquid water from its ionic components.

$$H^+_{(aq)} + Cl^-_{(aq)} + Na^{+1}_{(aq)} + OH^-_{(aq)} \rightleftharpoons Na^+_{(aq)} + Cl^-_{(aq)} + H_2O_{(\ell)}$$

The main reaction that takes place during neutralization is

$$H^+_{(aq)} + OH^-_{(aq)} \rightleftharpoons H_2O_{(l)} \qquad \Delta H_n = -57.4 kJ.mol^{-1}$$

Enthalpy of neutralization of any strong acid and strong base is approximately the same i.e -57 .4 kJ mol^{-1}.

Q.11 The standard enthalpy of formation of a compound is the amount of heat absorbed or evolved when one mole of compound is formed from its elements under standard conditions. It may be +ve or -ve

Q.12 Enthalpy of neutrilization & enthalpy of combustion are always negative, while enthalpy of atomization is always positive

Q.13 The standard enthalpy of neutralization is the amount of heat evolved when one mole of H^+ ions from an acid react with one mole of OH^- ions from a base to form one mole of water under standard conditions i.e. 298K and one atmosphere pressure.

Q.14

$$H_2SO_4 + Ba(OH)_2 \longrightarrow BaSO_4 + 2H_2O$$

$$2H^+ + 2OH^- \longrightarrow 2H_2O \qquad q_n = -114.8kJ$$

$$1H^+ + 1OH^- \longrightarrow 1H_2O \qquad \Delta H°n = -57.4kJ/mol$$

Q.15 Enthalpy of combustion is always negative. While enthalpy of solution may be negative or positive.

Q.16 Heat absorb or evolved during the chemical reaciton at constant pressure is known as enthalpy of reation. It is represnted by ΔH.

Q.17 The change in enthalpy of a system when one mole of the substance is completely burnt in excess of air or oxygen is called enthalpy of combustion.

$$C_2H_5OH_{(l)} + 3O_{2(g)} \longrightarrow 2CO_{2(g)} + 3H_2O_{(l)} \qquad \Delta H_c^\circ = -1368\ kJ.mol^{-1}$$

Q.18 ΔH_f = may be +ve or -ve

ΔH_{sol} = may be +ve or -ve

ΔH_c = always -ve

ΔH_{at} = always +ve

Q.19 Enthalpy of neutrilizaiton is a spontaneous process as well as exothermic.

$$H^+_{(aq)} + Cl^-_{(aq)} + Na^{+1}_{(aq)} + OH^-_{(aq)} \rightleftharpoons Na^+_{(aq)} + Cl^-_{(aq)} + H_2O_{(l)}$$

The main reaction that takes place during neutralization is

$$H^+_{(aq)} + OH^-_{(aq)} \rightleftharpoons H_2O_{(l)} \qquad \Delta H_n = -57.4\ kJ.mol^{-1}$$

Q.20 Standard conditions for enthalpy measurement are given below

Temperature = 25°C (298 K), Pressure = 1atm (760 torr)

Q.21 The enthalpy changes of a process is given by following relation

$$\Delta H = \Delta E + P\Delta V$$

Q.22

$\Delta E = q - w$

$= 100 - 50$ Work done on the surrounding by system is negative.

$= 50kJ$

Q.23 The standard enthalpy of atomization of an element is the amount of heat absorbed when one mole of gaseous atoms are formed from the element under standard conditions i.e. 298K and one atmosphere pressure.

Examples:

The standard enthalpy of atomization of hydrogen is given below

(i) $\frac{1}{2} H_{2(g)} \longrightarrow H_{(g)}$ $\Delta H^{\circ}_{at} = +218kJmol^{-1}$

(ii) $\frac{1}{2} I_{2(s)} \longrightarrow I_{(g)}$ $\Delta H_{at} = +ve$

Q.24 Standard conditions for enthalpy measurement are given below

Temperature = 25°C (298k), Pressure = 1atm

Q.25 (i) Enthalpy of solution and enthalpy of formation may be +ve or -ve.

(ii) Enthalpy of sublimation is always +ve while enthalpy of combustion is always -ve.

Q.26 1 mol of substance burnt in excess of oxygen enthalpy change is called enthalpy of combustion.

Q.27 Enthalpy of reaction can be measured by glass calorimeter or bomb calorimeter.

Q.28

$q = m \times s \times \Delta T$

$= 100 \times 4.2 \times 20$

$= 8400$

$= -8400J$

As heat released during reaction which is absorbed by H_2O.

Q.29 Enthalpyof combuistion of food, fuel and other compounds can be accurately measured by bomb calorimeter

$q = c \times \Delta T$

Q.30 Enthalpy of formation, enthalpy of neutrilization and enthalpy of solution can be determind by glass calorimeter. Enthalpy of combustion can be determind by bomb calorimeter.

Q.31 $q = c \times \Delta T$

where

c = heat capacity

ΔT = change in temperature

Q.32 Born-Haber cycle is applied to calculate lattice energy indirectly.

Q.33 Lattice energy of ionic compound can be calculated by following formula

$\Delta H_{latt} = \Delta H_f - \Delta H_x$

Q.34 The amount of heat which is released when one mole of ionic compound is formed from gaseous ions under standard conditions is called lattice energy.

$Na^+_{(g)} + Cl^-_{(g)} \rightarrow NaCl_{(s)}$ $\Delta H_{latt} = -787kJ/mol$

Q.35 ΔH_{latt} α Charge/Size Smaller

Q.36 If a chemical change takes place by several different routes, the overall energy change is the same, regardless of the route by which the chemical change occurs, provided the initial and final conditions are the same.

$$\Delta H = \Delta H_1 + \Delta H_2$$

OR

The sum of enthalpy changes in closed cycle is zero.

$\sum \Delta H(\text{cycle}) = 0$

Q.37 Born-Haber cycle is best application of Hess's law to calculate the lattic energy of ionic Compound

$\Delta H_{latt} = \Delta H_f - \Delta H_x$

Q.38 (i) Heat of formation of **Al_2O_3 and B_2O_3** cannot be measured directly. It is difficult to burn these substances completely in oxygen, as protective layer of their oxides is formed on the surface. So, for the determination of heat of formation of Al_2O_3 and B_2O_3 Hess's law is used.

(ii) Heat of formation of CO cannot be measured directly due to the formation of CO_2 with it.

Q.39 $C + O_2 \longrightarrow O_2$ $\Delta H = -394$ ________ (i)

$H_2 + \frac{1}{2}O_2 \longrightarrow H_2O$ $\Delta H = -286$ ________ (ii)

$C_3H_4 + 4O_2 \longrightarrow 3CO_2 + 2H_2O$ $\Delta H = -1938$ ________ (iii)

Required $3C + 2H_2 \longrightarrow C_3H_4$ $\Delta H = ?$

Multiply equation (i) with (iii), equation (ii) with (ii)

Reverse equation (iii) and adding them

$3C + 3O_2 \longrightarrow 3CO_2$ $\Delta H = -1182$

$2H_2 + O_2 \longrightarrow 2H_2O$ $\Delta H = -572$

$3CO_2 + 2H_2O \longrightarrow C_3H_4 + 4O_2$ $\Delta H = +1938$

$3C + 2H_2 \longrightarrow C_3H_4$ $\Delta H = -184$

Q.40 $C_2H_6 + \frac{1}{2}O_2 \longrightarrow 2CO_3 + 3H_2O$ $\Delta H = -337\text{kcal}$

30g of C_2H_6 produces heat = –337kcal

3g of C_2H_6 produces heat = –33.7kcal

EXPLANATORY NOTES

(PAST PAPER QUESTIONS)

Q.1 Characteristic of spontaneous reaction are

- Uni-directional
- Irreversible
- Real and naturall process

Q.2 For a exothermic reaction,

$\Delta H = -Ve$

For endothermic reaction,

$\Delta H = +Ve$

Q.3. For exothermic reaction,

$E_R > E_P$

For endothermic reaction,

$E_R < E_P$

Q.4 $CaO + H_2O \rightarrow Ca(OH)$, $\Delta H = -Ve$

Q.5 Enthalpies that always have –Ve value

- ΔH^o_c

ΔH^o_n

If bonds formed are stronger than bonds broken then reaction will be exothermic

Q.6 According to given diagram,

$E_R > E_P$

This indicate exothermic reaction

Q.7 For exothermic reaction, product are more stable than that of reactant

Q.8 $H^{+1}_{(g)} + H_2O_{(l)} \longrightarrow H_3O^{+1}_{(aq)}$ $\Delta H = -1075 kJ/mol$

Q.9 $\Delta H^\circ_a = +\ Ve$

For endothermic reaction, heat of surrounding decreases while heat of system increases

Q.10 $C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}$ $\Delta H^\circ_f = -394 kJ/mol$

Q.11 $H_{2(g)} + \frac{1}{2}O_{2(g)} \longrightarrow H_2O_{(l)}$, $\Delta H = -285.8 kJ/mol$

Q.12 Enthalpy of atomization (ΔH_{atm}) is heat change when 1 mole of gaseous atoms are produced from its element under standard condition

$\frac{1}{2}H_{2(g)} \longrightarrow H_{(g)}$, $\Delta H = +218 kJ/mol$

Q.13 ΔH°_{atm} is the heat change when 1 mole of gaseous atoms are produced from its element under standard condition

$\frac{1}{2}H_{2(g)} \longrightarrow H_{(g)}$, $\Delta H = +218 kJ/mol$

Q.14 ΔH°_f is the heat change when 1 mole of product is formed from its element under standard condition $Mg_{(s)} + \frac{1}{2}O_{2(g)} \longrightarrow MgO_{(s)}$ $\Delta H = -692 kJ/mol$

Q.15 $NH_4Cl_{(s)} \xrightarrow{H_2O} NH^{+1}_{4(aq)} + Cl^{-1}_{(aq)}$ $\Delta Hs = +16.11 kJ/mol$

Q.16 Condition to measure standard ΔH
Temp = 25°C / 298K
Pressure = 1atm
Substance must be in its original physical state

Q.17 ΔH_{atm} is the heat change when 1 mole of gaseous atoms are produced from its element under standard condition

Q.18 $2H_{2(g)} + O_{2(g)} \longrightarrow 2H_2O_{(l)}$, ΔH=-484kJ/mol

$H_{2(g)} + \frac{1}{2}O_{2(g)} \longrightarrow H_2O_{(l)}$, ΔH = -242kJ/mol

Q.19 Heat evolved when 1 mole of H^+ from acid and 1mole of OH^{-1} ion from base to give one mole of water under standard condition is called standard enthalpy of neutralization (ΔH_n°)

$CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$, $\Delta H_n^\circ \leq -57.4$kJ/mol

Q.20 If 2 mole H^+ from acid react with 2 mole of OH^{-1} from base to give 2 mole of water then ΔHn will be double (–114.8kJ)

Q.21 When one mole of ionic solid is produced from gaseous ions, then is called lattice enthalpy of formation. $X^{+1}_{(g)} + Y^{-1}_{(g)} \longrightarrow XY_{(s)}$ ΔH= – ve

Q.22 According to Hess's law of constant heat summation

$$\Delta H_1 = \Delta H_2 + \Delta H_3$$
$$-393.7 = \Delta H_2 - 283$$
$$\Delta H_2 = -393.7 + 283$$
$$= -110.7\text{kJ/mol}$$

Q.23 Lattice energy can be calculated by Born Haber Process

$$\Delta H_l = \Delta H_f - \Delta H_x$$
$$= -411 - [107 + 122 + 496 - 349]$$
$$= -411 - 376$$
$$= -787 kJ / mol$$

Q.24 Lattice energy can be calculated by Born Haber process

$$\Delta H_l = \Delta H_f - \Delta H_x$$
$$\Delta H_l = -392 - [112 + 420 + 90 - 342]$$
$$= -392 - 280$$
$$= -672\text{kJ/mol}$$

Q.25 Heat and work are not state function rather they are path function

Q.26 $q_p = \Delta H$, Heat of reaction at constant pressure is equal to enthalpy change (ΔH)

Q.27 Born Haber cycle is application of Hess's law used to find ΔH_f° of binary ionic compound

Q.28 1 Cal = 4.184 J

Topic 9

ELECTROCHEMISTRY

PRACTICE EXERCISE

Q.1 **The oxidation state of carbon-atom in glucose is**

A. +4
B. -4
C. +6
[✓ D. None of these]

Q.2 **In which of the following substance does sulphur exhibit its highest oxidation state**

A. S_8
B. SO_2
[✓ C. SO_2Cl_2]
D. $Na_2S_2O_3$

Q.3 **What is the oxidation state of oxygen is KO_2**

[✓ A. $-\frac{1}{2}$]
B. –2
C. –1
D. –3

Q.4 **Apparent charge on an atom of an element in a molecule or ion is called oxidation number. It may be**

A. Positive
B. Zero or fraction
C. Negative
[✓ D. All of these]

Q.5 **Apparent charge on atom in molecule is**

A. Valency
B. Coordination number
[✓ C. Oxidation number]
D. Charge number

Q.6 **The oxidation number of oxygen atom in OF_2 and H_2O_2**

A. –2, –1
[✓ B. +2, –1]
C. –1, +2
D. +2, +1

Q.7 **The element on the reactant side which has been reduced is**

$$HI + H_2SO_4 \longrightarrow I_2 + SO_2 + H_2O$$

A. H
B. I
[✓ C. S]
D. O

Q.8 **A redox reaction is**

$$MnO_{2(s)} + 4H^+ \longrightarrow \overset{+2}{Mn}_{(aq)} + 2H_2O$$

[✓ A. $2e^-$ are added on LHS]
B. $2e^-$ are added on RHS
C. $4e^-$ are added on LHS
D. $4e^-$ are added on RHS

Q.9 **In which of the following changes there is a transfer of the five electrons**

A. $MnO_4^{2-} \rightarrow MnO_2$
B. $CrO_4^{2-} \rightarrow Cr^{+3}$
[✓ C. $MnO_4^{1-} \rightarrow Mn^{+2}$]
D. $Cr_2O_7^{-2} \rightarrow 2Cr^{+2}$

Q.10 **In the reaction $H_2S + Cl_2 \rightarrow 2HCl + S$, H_2S acts as**

[✓ A. Reducing agent]
B. Nitrating agent
C. Oxidizing agent
D. Sulphonating agent

Q.11 **$8H^+ + MnO_4^- \longrightarrow Mn^{2+} + 4H_2O$, which one is correct about given equation**

A. $5e^-$ in R.H.S
[✓ B. $5e^-$ in L.H.S]
C. $3e^-$ in R.H.S
D. $3e^-$ in L.H.S

Q.12 **Which of the following reactions occur at cathode**

[✓ A. $Cu^{2+} + 2e^- \rightarrow Cu$]
B. $Cu + 2e^- \rightarrow Cu^{2+}$
C. $Hg + \frac{1}{2}O_2 \rightarrow HgO$
D. $Mg + \frac{1}{2}O_2 \rightarrow MgO$

Q.13 In which of the following changes there is a transfer of two electrons

[✓ A]. $MnO_4^{2-} \longrightarrow MnO_2$

B. $MnO_4^{-} \longrightarrow Mn^{+2}$

C. $CrO_4^{2-} \longrightarrow Cr^{+3}$

D. $Cr_2O_7^{2-} \longrightarrow 2Cr^{+3}$

Q.14 The reaction taking place at anode and cathode are respectively.

[✓ A]. Oxidation and reduction

B. Reduction and hydrolysis

C. Reduction and oxidation

D. Oxidation and hydrolysis

Q.15 The electrolysis product of molten NaCl at electrodes

[✓ A]. Na and Cl_2

B. H_2 and Cl_2

C. Na and NaOH

D. H_2, Cl_2 and NaOH

Q.16 During the electrolysis of aqueous KNO_3, H_2 is produced at cathode instead of potassium due to

A. Reduction potential of "K" is greater than hydrogen

B. Hydrogen is more reactive than potassium

[✓ C]. Reduction potential of potassium is less than hydrogen

D. All of the above are possible reasons

Q.17 The cathodic reaction in the electrolysis of dil H_2SO_4 with Pt electrodes

[✓ A]. Reduction

B. Both oxidation and reduction

C. Oxidation

D. Neither oxidation nor reduction

Q.18 The product produced at the cathode when aqueous sodium chloride is electrolyzed

[✓ A]. H_2

B. Cl_2

C. O_2

D. Na

Q.19 For the purification of copper, impure copper is made the_______

A. Cathode

B. Solution

[✓ C]. Anode

D. Both A & B

Q.20 Cell potential depends upon

A. Temperature

B. Concentration of ions

C. Nature of electrolyte

[✓ D]. All of these

Q.21 When an element is in contact with 1M aqueous solution of its own ions, at 298K then potential is called?

A. Standard reduction potential

B. Standard electrode potential

C. Reduction potential

[✓ D]. Both "A" and "C"

Q.22 The electric current obtained from galvanic cell is a result of electrons being pushed forced from the negative electrode, through an external wire, to positive electrode. The force with which these electrons move through the wire is called

A. Electromotive force

B. Electrode potential

C. Cell potential

[✓ D]. Both A. and C.

Q.23 Which is incorrect about standard electrode potential

A. It is the difference of potential of a cell, consisting of particular electrode and the SHE

B. The potential set up, when an electrode is in contact with one molar solution of its ions at standard conditions

[✓ C]. The electrode potential of a single electrode can be measured directly

D. Both A and B

Q.24 Which is not true about SHE

A. Finely divided platinum black is used as electrode

B. Temperature is kept 25°C

[✓ C]. One molar solution of H_2SO_4 is used as electrolyte

D. Electrode potential of any element can be calculated by comparison method

Q.25 **The oxidation reaction that takes place in the SHE is**

[✓ A.] $H_{2(gas)} \longrightarrow 2H^{+}_{(aq)} + 2e^{-}$

B. $2H_2O_{(l)} \longrightarrow 2H_{2(g)} + O_{2(g)}$

C. $2H^{+}_{(aq)} + 2e^{-} \longrightarrow H_{2(gas)}$

D. $2H_2O_{(l)} + 2e^{-} \longrightarrow OH^{-}_{(aq)} + H_{2(g)}$

Q.26 **The working condition/s for SHE**

A. 1atm pressure

B. 1M H^+ solution.

C. 298K temperature

[✓ D.] All of these.

Q.27 **The potential of SHE is taken as zero which is a __________ value**

A. Reference

[✓ B.] Arbitrary

C. Exact

D. Experimental

Q.28 **The electrochemical series is based on**

A. pH scale

B. Redox scale

[✓ C.] Hydrogen scale

D. Arrhenius scale

Q.29 **SHE acts as anode when connected with Cu electrode but act as cathode with Zn electrode, which one is correct**

A. Zn has less reduction potential than hydrogen and Cu more

B. Zn has high oxidizing potential than hydrogen and Cu more

C. Zn is above in electrochemical series than hydrogen and Cu below

[✓ D.] All the above are correct

Q.30 **If a salt bridge is removed from two half cells the emf is**

A. Increased

B. Decreased

[✓ C.] Dropped to zero

D. Electrodes will be reversed

Q.31 **The cathode has the reduction potential**

A. Less than anode

B. The same as anode

[✓ C.] More than anode

D. Always zero

Q.32 **$Al / Al^{+3} \parallel Zn^{+2} / Zn$ galvanic cell, the anode is**

[✓ A.] Al

B. Zn

C. H_2

D. KCl

Q.33 **Li has least reduction potential in electrochemical series. Which element has highest E^{o}_{red}**

A. N

[✓ B.] F

C. O

D. Cl

Q.34 **The value of oxidation potential would be positive if it is**

A. Below SHE

[✓ B.] Above SHE

C. Equal to SHE

D. Both A and B

Q.35 **In the following cell representation**

$$Zn_{(s)}\left|Zn^{2+}_{(aq)}(1M)\right|\left|Cu^{2+}_{(aq)}(1M)\right|Cu_{(s)}$$

The line $\parallel$ in the representation shows

[✓ A.] Salt bridge

B. Molar concentration

C. Phase boundary

D. Both A and B

PAST PAPER QUESTIONS

Q.1 The reaction which is responsible for the production of electricity in the voltaic cell is **MDCAT (2010)**

A. Hydrolysis
B. Oxidation
C. Reduction
[✓ D. Redox]

Q.2 In all oxidation reactions, atoms of an element in a chemical species lose electrons and increases their **MDCAT (2011)**

[✓ A. Oxidation states]
B. Electrode
D. Negative charges

Q.3 In $MgCl_2$, the oxidation state of Cl is **MDCAT (2012)**

A. Zero
B. -2
C. +2
[✓ D. -1]

Q.4 Which one of the following behave as a redox reaction? **MDCAT (2013)**

A. $NaCl + AgNO_3 \rightarrow NaNO_3 + AgCl$
[✓ B. $2Na+Cl_2 \rightarrow 2NaCl$]
C. $2Cl^- \rightarrow Cl_2+2e^-$
D. $Na^+ + 1e^- \rightarrow Na$

Q.5 In SO_4^{-2} the oxidation number of sulphur is **MDCAT (2014)**

A. −8
B. −6
C. +8
[✓ D. +6]

Q.6 Study the following redox reaction: **MDCAT (2016)**

$$10Cl^- + 16H^+ + 2MnO_4^- \longrightarrow 5Cl_2 + 2Mn^{+2} + 8H_2O$$

Which statement is true about this reaction?

A. Manganese is oxidized from +7 to +2.
B. Chlorine is reduced from zero to -1
C. Chloride ions are reduced from -1 to zero
[✓ D. Manganese is reduced from +7 to +2]

Q.7 In NO_3^- the oxidation number of N is **MDCAT (2017)**

[✓ A. +5]
B. +3
C. +2
D. −3

Q.8 The oxidation state of carbon in $C_2O_4^{-2}$ is **NUMS (2019)**

A. +4
B. −4
[✓ C. +3]
D. +2

Q.9 The value of oxidation number of chlorine in $HClO_3$ is **SET (2019)**

A. +7
[✓ B. +5]
C. −1
D. +3

Q.10 In voltaic cell a salt bridge is used in order to **MDCAT (2011)**

A. Pass the electric current
B. Prevent the flow of ions
C. Mix solutions of two half cells
[✓ D. Allow movement of ions between two cells]

Q.11 The potential difference of an electrochemical cell is measured by **MDCAT (2018)**

A. Galvanometer
B. Calorimeter
[✓ C. Voltmeter]
D. Ammeter

Q.12 In an electrochemical series, elements are arranged on the basis of: **MDCAT (2010)**

A. pH scale
B. pKa scale
C. pOH scale
[✓ D. Hydrogen scale]

Q.13 **The E° value of standard copper half-cell is +0.34V, measured when it is connected with SHE i.e. Standard hydrogen electrode. In this case the half reaction taking place at SHE is** **MDCAT (2017)**

A. $2H^+_{(aq)} + 2e^- \longrightarrow H_{2(g)}$
B. $H_{2(g)} \longrightarrow 2H^+_{(aq)} + 2e^-$
C. $2H^+_{(aq)} + 2e^- \longrightarrow 2H_{(g)}$
D. $H_{2(g)} \longrightarrow 2H_{(g)} + 2e^-$

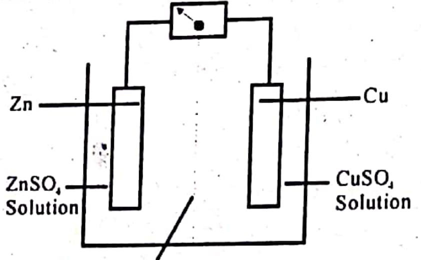
Q.14 **The standard electrode potential of hydrogen is arbitrarily taken at 298k is** **MDCAT (2018)**

A. 1.00volt
B. 0.10 volt
C. 0.00 volt
D. 10.0 volt

Q.15 **Coinage metals Cu, Ag and Au are the least reactive because they have** **MDCAT (2016)**

A. Negative reduction potential
B. Negative oxidation potential
C. Positive reduction potential
D. Positive oxidation potential

Q.16 **In the figure given below, the electron flow in external circuit is from** **MDCAT (2013)**



Porous Partition

A. Zinc to copper electrode
B. Right to left
C. Copper to zinc electrode
D. porous partition to zinc electrode

Q.17 **Study the following facts** **MDCAT (2015)**

$$Zn \longrightarrow Zn^{+2} + 2e^- \quad E° = +0.76V$$

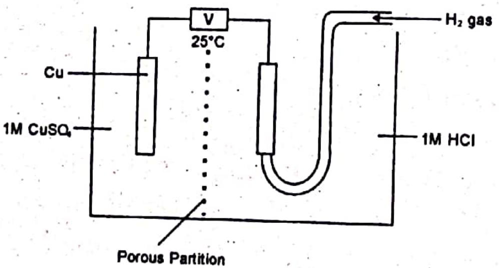
$$Cu \longrightarrow Cu^{+2} + 2e^- \quad E° = -0.34V$$

A. $Cu + Zn^{+2} \longrightarrow Cu^{+2} + Zn$
B. $Cu^{+2} + Zn \longrightarrow Cu + Zn^{+2}$
C. $Cu^{+2} + Zn^{+2} \longrightarrow Cu + Zn$
D. $Cu^{+2} + Zn^{+2} \longrightarrow Cu + Zn^{+2}$

Q.18 **Keeping in mind the electrode potential, which one of the following reactions is feasible?** **MDCAT (2015)**

A. $Zn^{+2} + Cu \longrightarrow Cu^{+2} + Zn$
B. $Fe + CuSO_4 \longrightarrow FeSO_4 + Cu$
C. $Zn + MgSO_4 \longrightarrow ZnSO_4 + Mg$
D. $Cd + MgSO_4 \longrightarrow CdSO_4 + Mg$

Q.19



Porous Partition

The diagram shows a galvanic cell. The current will flow from **MDCAT (2016)**

A. Hydrogen electrode to copper electrode
B. Copper electrode to hydrogen electrode
C. Hydrogen electrode to HCl solution
D. $CuSO_4$ solution to hydrogen electrode

Q.20 Stronger is the oxidizing agent, stronger is the NUMS (2019)

A. emf of cell
B. Oxidation potential
[✓ C. Reduction potential]
D. Redox potential

Q.21 Which of the following metal does not liberate hydrogen on reaction with acid? NUMS (2019)

A. Mg
[✓ B. Pt]
C. Zn
D. Ca

Q.22 Which one of the following elements is the strongest reducing agent? SET (2019)

A. Chlorine
[✓ B. Sodium]
C. Magnesium
D. Aluminium

Q.23 Rusting of iron metal Fe occurs when Fe gets converted into Fe_2O_3. What happen with Fe? SET (2019)

A. Fe is neutralized
B. Fe is sublimed
C. Fe is reduced
[✓ D. Fe is oxidized]

Q.24 During space flights, astronauts obtained water from MDCAT (2017)

A. Nickel cadmium cells
B. Lead accumulator
[✓ C. Fuel Cell]
D. Alkaline battery

Q.25 The electrolyte used in fuel cell is NUMS (2019)

[✓ A. KOH]
B. NaCl(aq)
C. $NaNO_3$
D. Molten NaCl

Q.26 In which of the following reaction hydrogen acts as oxidizing agent. ETEA (2016)

A. $H_2 + Cl_2 \longrightarrow 2HCl$
B. $C_2H_4 + H_2 \longrightarrow C_2H_6$
[✓ C. $2Na + H_2 \longrightarrow 2NaH$]
D. $N_2 + 3H_2 \longrightarrow 2NH_3$

Q.27 Choose the true statement regarding the reaction given below ETEA (2016)

$$2Na_{(g)} + Cl_{2(g)} \longrightarrow 2NaCl_{(g)}$$

A. Chloride is oxidized and sodium is reduced
[✓ B. Chlorine acts as an oxidizing agent and sodium as reducing agent]
C. Chloride acts as a reducing agent and
D. None of the above

Q.28 A cell is constructed of the following two half cells. What is E^+ of the cell? ETEA (2016)

$Ag^+ + e^- \rightleftharpoons Ag + 0.80V$ $Al^{3+} + e^- \rightleftharpoons Al - 1.67V$

[✓ A. 2.47V]
B. 0.087
C. –0.87 V
D. 5.81 V

Q.29 Which of the following is spontaneous reactions? ETEA (2016)

[✓ A. $Zn + Cu^{2+} \longrightarrow Zn^{2+} + Cu$]
B. $2NaCl_{(g)} \longrightarrow 2Na_{(g)} + Cl_{2(g)}$
C. $Zn^{2+} + Clu \longrightarrow Zn + Cu^{2+}$
D. $2Fe(OH)_3 \longrightarrow 2Fe + 3O_2 + 3H_2$

Q.30 When zinc electrode is coupled with copper electrode in a galvanic cell ETEA (2019)

A. Reduction takes place at zinc electrode [✓ C. Oxidation takes place at copper electrode]
B. Reduction takes place at copper electrode D. Both A and B

Q.31 The oxidation state of nitrogen in NH_4NO_3 are ETEA (2019)

[✓ A. 3 and 5]
B. +5 and 3
C. -3 and -3
D. Zero

Q.32 **Aqueous solutions of Iodine and Sodium hydroxide were mixed in a round bottom flask at 70°C. Following chemical reaction was carried out.** **MDCAT (2019)**

$3I_2 + 6NaOH \rightarrow NaIO_3 + NaI + H_2O$

This reaction is termed as

A. Free radical reaction
B. Precipitation reaction
C. Substitution reaction
[✓ D. Redox reaction]

Q.33

$Mg^{2+} + 2e^- \rightarrow Mg \quad E^\circ = -2.37V$

$Zn^{2+} + 2e^- \rightarrow Zn \quad E^\circ = -0.76V$

$2H^+ + 2e^- \rightarrow H_2 \quad E^\circ = 0.000V$

$Cu^{2+} + 2e^- \rightarrow Cu \quad E^\circ = +0.34V$

$Cl_2 + 2e^- \rightarrow 2Cl^- \quad E^\circ = +1.36V$

$Au^{3+} + 3e^- \rightarrow Au \quad E^\circ = +1.50V$

Keeping in view the values of standard reduction potential given above, which one of the following would you select as a feasible redox chemical reaction? **MDCAT (2019)**

A. $2Au + 6H^+ \rightarrow 2Au^{3+} + 3H_2$
B. $2Cl^- + I_2 \rightarrow Cl_2 + 2I^-$
[✓ C. $Mg + 2H^+ \rightarrow Mg^{2+} + H_2$]
D. $Cu + Zn^{2+} \rightarrow Cu^{2+} + Zn$

Q.34 **The oxidation state of "S" in the $(S_2O_3)^{-2}$ is:** **NMDCAT (2020)**

A. +4
B. +6
C. -2
[✓ D. +2]

Q.35 **The common oxidation number of halogens is** **NMDCAT (2020)**

[✓ A. -1]
B. +1
C. -2
D. 0

Q.36 **During oxidation process, oxidation number of an element** **NMDCAT (2020)**

A. Decreases
[✓ B. Increases]
C. Remains constant
D. Both a and b

ANSWER KEY

1	D	11	B	21	D	31	C
2	C	12	A	22	D	32	A
3	A	13	A	23	C	33	B
4	D	14	A	24	C	34	B
5	C	15	A	25	A	35	A
6	B	16	C	26	D		
7	C	17	A	27	B		
8	A	18	A	28	C		
9	C	19	C	29	D		
10	A	20	D	30	C		

PAST PAPER QUESTIONS

1	D	6	D	11	C	16	A	21	B	26	C	31	A	36	B
2	A	7	A	12	D	17	A	22	B	27	B	32	D		
3	D	8	C	13	B	18	B	23	D	28	A	33	C		
4	B	9	B	14	C	19	A	24	C	29	A	34	D		
5	D	10	D	15	C	20	C	25	A	30	C	35	A		

EXPLANATORY NOTES

Q.1 Net charge on carbon in glucose is zero.

$C_6H_{12}O_6$

$6x + 12 + (-2)6 = 0$ Let x be net oxidation state of carbon.

$6x = 0$

$x = 0$

Q.2

S_8	0
SO_2Cl_2	$x + 2(-2) + 2(-1) = 0$ $x - 4 - 2 = 0$ $x = +6$
SO_2	$x + 2(-2) = 0$ $x = 4$
$Na_2S_2O_3$	$2(+1) + 2x + 3(-2) = 0$ $2 + 2x - 6 = 0$ $2x - 4 = 0$ $2x = +4$ $x = 2$

Q.3 Let x be oxidation state of "O" KO_2

$+1 + 2x = 0$

$2x = -1$

$x = -\frac{1}{2}$

Q.4 Oxidation state is apparent charge on atom which may be zero, fractional, positive or negative.

Q.5 Apparent charge on atom in molecule is called oxidation number.

Q.6 **OF_2**

$O + 2(-1) = 0$

$O - 2 = 0$

$O = +2$

H_2O_2

$2(+1) + 2O = 0$

$2O = -2$

$O = -1$

Q.7 $HI + H_2SO_4 \rightarrow I_2 + SO_2 + H_2O$. The oxidation number of sulphur is reduced from +6 to +4.

Q.8 $MnO_2 + 4H^+ \longrightarrow Mn^{+2} + 2H_2O$

+4 +2

In order to balance charge 2 electrons, have to be added on L.H.S.

$MnO_2 + 4H^+ + 2e^- \longrightarrow Mn^{+2} + 2H_2O$

Q.9

Reaction	Change in O.S	Transfer of es⁻
$MnO_4^{-2} \longrightarrow MnO_2$	$+6 \longrightarrow +4$	2
$MnO_4^{-1} \longrightarrow Mn^{+2}$	$+7 \longrightarrow +2$	5
$CrO_4^{-2} \longrightarrow Cr^{+3}$	$+6 \longrightarrow +3$	3
$CrO_4^{-2} \longrightarrow Cr^{+3}$	$2(+6 \longrightarrow +3)$	3×2

Q.10 $H_2S \longrightarrow S$ oxidation state of S changes from –2 to 0. Hence it is oxidized by Cl_2 making H_2S reducing agent at, Cl_2 is reduced to Cl^- substance oxidation state (x).

Q.11 $8H^+ + MnO_4^- \longrightarrow Mn^{2+} + 4H_2O$. The oxidation number of Mn in MnO_4^- is +7 and in Mn^{2+} is +2. The reduction takes place in given reaction. 5 electrons are added in L.H.S.

Q.12 Reduction takes place at cathode which is addition of electrons in the reaction.

$Cu^{2+} + 2e^- \rightarrow Cu$

Q.13 A. $MnO_4^{2-} \longrightarrow MnO_2$

oxidation number of Mn in MnO_4^{2-} is +6 and in MnO_2 is +4. Hence there is transfer of two electrons.

C. $CrO_4^{2-} \longrightarrow Cr^{+3}$

Oxidation number of Cr in CrO_4^{2-} is +6 and in Cr^{+3} is +3. Hence there is transfer of 3 electrons.

B. $MnO_4^- \longrightarrow Mn^{+2}$

Oxidation number of Mn in MnO_4^- is +7 and in Mn^{2+} is +2. Hence there is transfer of 5 electrons.

D. $Cr_2O_7^{2-} \longrightarrow 2Cr^{+3}$

Oxidation number of chromium in $Cr_2O_7^{2-}$ is +6 and in Cr^{3+} is +3. Hence there is transfer of 3 electrons.

Q.14 Oxidation takes place at anode and reduction takes place at cathode.

Q.15 For molten NaCl

At anode

$2Cl^- \longrightarrow Cl_2 + 2e^-$

At cathode

$2Na^+ + 2e^- \longrightarrow 2Na$

Net reaction

$2NaCl \longrightarrow 2Na + Cl_2$

Q.16 Reduction potential of potassium is less than hydrogen. H^+ will be reduced instead of K^+ at cathode and hydrogen gas is produced.

$K^+ + 1e^{-1} \rightarrow K$ $E^\circ = -2.92V$

$2H^{+1} + 2e^{-1} \rightarrow H_2$ $E^\circ = 0.00V$

Q.17 Electrolysis of dilute H_2SO_4.

At anode: O_2 is produced (Oxidation)

At cathode: H_2 is produced (Reduction)

Q.18 For aqueous solution of NaCl at cathode.

H_2O is reduced to H_2 as its E°_{red} is higher than Na^+.

$2H_2O + 2e^- \longrightarrow H_2 + 2OH^-$

Q.19 Electrolytic cell is used for the purification of copper. Impure copper is made the anode and thin sheet of pure copper is made the cathode and copper sulphate solution is used as an electrolyte.

Q.20 As reduction potential of electrodes changes by change in
i) Temperature
ii) Concentration of ions
iii) Nature of electrolyte
Hence cell potential also changes.

$E^\circ_{cell} = E^\circ_{oxidation} + E^\circ_{reduction}$

Q.21 Standard electrode potential is measured at 298K for electrode in 1M aqueous solution of its ions, which is also called standard reduction potential.

Q.22 emf or cell potential is the force to drive electron in a circuit.

Q.23 Electrode potential is measured by comparing it with SHE.

Q.24 Conditions for SHE
i) Pt electrode coated with finely divided Pt black
ii) $T = 25°C = 298k$
iii) $1M = H^+$ ions (1M HCl)
iv) $P = 1$ atm
As one molar $H_2SO_4 = 2M\ H^+$ hence it is not correct.

Q.25 In SHE H_2 gas is oxidized to H^+ ions by loss of electron $H_{2(g)} \longrightarrow 2H^+_{aq} + 2e^-$

Q.26 Conditions for SHE
i) Pt electrode coated with finely divided Pt black
ii) $T = 25°C = 298k$
iii) $1M = H^+$ ions
iv) $P = 1$ atm

Q.27 SHE itself is a reference electrode hence its E°_{red} is taken as zero Arbitrary value i.e. without any other reference.

Q.28 ECS shows E°_{red} value in ascending order and E°_{red} is measured by comparing with SHE i.e. H-scale.

Q.29 In ECS Zn has less reduction potential than hydrogen and Cu. Zn is above in ECS and Cu is below.

Q.30 Salt bridge maintain the electrical neutrality between two half cells preventing net charge accumulation which will occur. If salt bridge is removed then emf will drop to zero.

Q.31 At cathode reduction takes place hence it has greater E°_{red} than anode.

Q.32 $Al \xrightarrow{\text{oxidation}} Al^{+3} + 3e^-$, as Al is oxidized hence it acts as anode while zinc will act as cathode and is reduced.

Q.33 Fluorine is very strong oxidizing agent and is at the bottom of ECS. Indicating its highest $E^\circ_{red} = +2.87V$

Q.34 In ECS elements above SHE have negative E°_{red}, $E^\circ_{oxi} = -E^\circ_{red}$. Hence elements with negative E°_{red} have positive E°_{oxi}.

Q.35 $Zn_{(s)}\left|Zn^{2+}_{(aq)}(1M)\right\|Cu^{2+}_{(aq)}(1M)\left|Cu_{(s)}\right.$

| Represents the phase boundary and || represents salt bridge.

EXPLANATORY NOTES

(PAST PAPER QUESTIONS)

Q.1 Voltaic cell converts the chemical energy into electrical energy by the help of Redox reaction where oxidation takes place at anode while reduction at cathode.

Q.2 Oxidation takes place by removal of electron and causes the increase in oxidation state.

Q.3 Oxidation state of Mg

$x + (-1)2 = 0$

$x = +2$

Q.4 When sodium reacts with chlorine sodium loses electron and get oxidized while Cl gains electron and reduces itself so both oxidation and reduction is taking place so it will be redox reaction.

Q.5 Oxidation No of S

$x + (-2)4 = -2$

$x = -2 + 8$

$x = +6$

Q.6 In the reaction Mn^{+7} gains $5e^{-1}$ and get reduced to Mn^{+2}

Q.7 Oxidation No of N

$x + (-2)3 = -1$

$x = -1 + 6$

$x = +5$

Q.8 Oxidation No of C

$2x + (-2)4 = -2$

$2x = -2 + 8$

$x = +3$

Q.9 Oxidation No of Cl

$x + (-2)4 + (+1) = 0$

$x = +7$

Q.10 The function of salt bridge is to connect the two half cell to allow the passage of ions to stop the potential dropping to zero.

Q.11 Volt meter is a device that is used to measure potential.

Q.12 Electrochemical series is a series arranged on the basis of Hydrogen scale or increasing reduction potential.

Q.13 As Cu is positioned down as SHE in Electrochemical series so SHE will get oxidized and will lose electron.

Q.14 Potential of SHE is taken as arbitrarily zero.

Q.15 Coinage metal lies below Hydrogen in Electrochemical series so They have high value of Reduction potential.

Q.16 Flow of electron is always from anode to cathode so it will be from Zinc to Cu.

Q.17 Oxidation potential of Zn is greater than that of cooper so Zinc will get oxidized while cooper will get reduced.

Q.18 As Fe lies above Cooper in ECS so it will easily replace Cu.

Q.19 In the Cell SHE will act as anode and will transfer its electron to Cu which will act as cathode.

Q.20 Reduction potential is directly proportional to oxidizing power.

Q.21 Pt is considered as a noble metal.

Q.22 Na is strongest reducing agent because it has least value of reduction potential.

Q.23 Rusting of Iron means oxidation of Iron so Iron will get oxidized.

Q.24 One of the advantages of fuel cell is that it does not produce pollution and produces water which is utilized by Astronauts.

Q.25 Fuel cell uses KOH as electrolyte.

Q.26 During reaction with Sodium Hydrogen gains electrons and acts as a oxidizing agent.

Q.27 In the above reaction sodium loses electrons means it is oxidized so Na is reducing agent while Cl gains electron so it is reduced and will act as oxidizing agent.

Q.28 $E_{cell} = E_{oxi} + E_{red}$

$E_{cell} = 0.80 + 1.67$

$E_{cell} = 2.47$

Q.29 The cell potential of Daniels Cell is 1.1V so it will be spontaneous reaction.

Q.30 When Cu is Coupled with Zn will be oxidized while Cu will reduce.

Q.31 Oxidation no of N in NH_4^+ is -3 while in NO_3^{-1} it is +5

Q.32 In the reaction both oxidation and reduction takes place so it is redox reaction.

Q.33 Cell EMF of Mg-SHE cell is highest of all of them. So, it is most feasible reaction.

Q.34 Oxidation number of S

$2x + (-2)3 = -2$

$2x = -2 + 6$

$x = +2$

Q.35 Most Common oxidation state of halogen is -1

Q.36 During oxidation there is removal of electron which causes increase in oxidation state.

Topic 10

CHEMICAL BONDING

PRACTICE EXERCISE

Q.1 Which of the following has largest ionic size
A. F^-
B. O^{2-}
[✓ C. N^{3-}]
D. Na^+

Q.2 In a period, the atomic radii
A. Increases
[✓ B. Decreases]
C. Remain same
D. First decreases, then increases

Q.3 Which of the following is correct relation for atomic radius
[✓ A. $A^- > A > A^+$]
B. $A > A^+ > A^-$
C. $A^+ > A > A^-$
D. $A^- > A^+ > A$

Q.4 Ionization energy depends upon
A. Atomic/ionic radii
B. Shielding effect
C. Nature of orbital
[✓ D. All of the above]

Q.5 Which of the following has highest ionization energy value
A. Li
B. H
C. Be
[✓ D. He]

Q.6 Greater shielding effect corresponds to______ ionization energy value
A. Greater
B. Zero
[✓ C. Lesser]
D. Variable

Q.7 The group that has maximum 1st ionization energy values
A. ns^1
B. ns^2
C. ns^2, np^5
[✓ D. ns^2, np^6]

Q.8 Which of following group has maximum 1st electron affinity values in same period
A. V A
B. VI A
[✓ C. VII A]
D. VIII A

Q.9 Which of the following element has lowest electron affinity
A. N
B. Cl
C. O
[✓ D. He]

Q.10 An ionic compound A^+B^- is most likely to form when:
A. Ionization energy of A is high and electron affinity of B is low
[✓ B. Ionization energy of A is low and electron affinity of B is high]
C. Both the ionization energy and the electron affinity of A and B are high
D. Both the ionization energy and the electron affinity of A and B are low

Q.11 Formation of ionic bond is favoured by
A. High I. E of metal
B. Low lattice energy
C. Low E.A of nonmetal
[✓ D. Low I.E of metal]

Q.12 Maximum ionic character is exhibited by
A. NaCl
[✓ B. CsF]
C. KCl
D. HF

Q.13 All of the following species have dative bond except
[✓ A. OH^-]
B. BF_4^-
C. $\overset{+}{N}H_4$
D. H_3O^+

Q.14 **Co-ordinate covalent bond is present in**
A. Nitride ion
B. Chloronium ion
[✓ C. Hydronium ion]
D. All of these

Q.15 **The percentage of co-ordinate covalent bond present in BF_4^- and NH_4^+ respectively**
A. 25% and 33%
B. 33% each
C. 33% and 25%
[✓ D. 25% each]

Q.16 **If the sharing of an electron pair is unequal and the atom have an electronegativity difference of 1.4 to 1.6, what is this type of sharing called**
A. Ionic
[✓ B. Polar covalent]
C. Non-polar covalent
D. Metallic

Q.17 **The following molecules has linear structure except?**
A. CS_2
B. CO_2
[✓ C. SO_2]
D. $BeCl_2$

Q.18 **Which of the following species has lone pair of electrons on central atom?**
A. CH_4
B. PCl_5
C. NH_4^+
[✓ D. PCl_3]

Q.19 **Which pair has trigonal planar geometry**
A. NH_3, PH_3
[✓ B. BF_3, AlH_3]
C. H_2O, C_2H_2
D. CO_2, SO_2

Q.20 **The shape of NH_2^- is**
A. Linear
[✓ B. Angular]
C. Pyramidal
D. Tetrahedral

Q.21 **Which molecular geometry is not possible for AB_4 type molecules**
[✓ A. Trigonal planar]
B. Tetrahedral
C. Trigonal pyramidal
D. Angular

Q.22 **The correct order of bond angles is represented in**
[✓ A. $CH_4 > H_2O > NF_3 > H_2S$]
B. $H_2S > H_2O > CH_4 > NF_3$
C. $CH_4 > NF_3 > H_2O > H_2S$
D. $CH_4 > H_2S > H_2O > NF_3$

Q.23 **Which of the following has perfect triangular structure**
A. CO_2
B. PH_3
C. NO
[✓ D. SO_3]

Q.24 **Limitation to valence bond theory (VBT) is that:**
A. It doesn't address the shapes of the molecules
B. It doesn't involve the criteria of bond formation
[✓ C. It doesn't explain paramagnetic behavior of O_2]
D. None of the above

Q.25 **End to end overlapping of orbitals give rise to the formation of:**
[✓ A. Sigma bond]
B. Pi bond
C. Metallic bond
D. Co-ordinate covalent bond

Q.26 **Pi bonds are formed by overlapping of**
[✓ A. Un-hybrid orbitals]
B. Hybrid orbitals
C. Hybrid and un-hybrid orbitals
D. Atomic orbital and hybrid orbital

Q.27 **The concept of hybridization was given to remove which of following drawback (s) of V.B.T**

A. It does not explain paramagnetism of O_2

B. It does not explain odd electron system

[✓ C. It could not explain tetravalency of carbon]

D. All of above

Q.28 **Cl_2 molecule is formed by the overlap of**

A. s-s orbital

[✓ B. p-p head on overlapping of orbitals]

C. s-p orbital

D. p-p parallel overlapping of orbitals

Q.29 **The process in which the orbitals of different energies and shape mix with each other to give equivalent hybrid orbitals is called:**

A. Dissolution

B. Resonance

[✓ C. Hybridization]

D. Ionization

Q.30 **In which of following species central atom is not sp^3 hybridized**

A. NH_4^+

B. $\bar{N}H_2$

C. NH_3

[✓ D. NO_3^-]

Q.31 **In ground state the unpaired electrons in carbon are**

A. 1

B. 3

[✓ C. 2]

D. 4

Q.32 **The central atom which may not follow the octet rule while forming covalent bond**

A. C

[✓ B. O]

[✓ C. P] ✓

D. F

Q.33 **Which one shows high %age of the ionic character**

A. HI

[✓ B. HF]

C. HCl

D. HBr

Q.34 **Dipole moment gives the information about:**

A. % ionic character

B. Bond angles

C. Geometry of the molecules

[✓ D. All of the above]

Q.35 **Bond length depends upon**

A. Hybridization on central atom

B. Nature of molecule

C. Size of central atom

[✓ D. All of these]

Q.36 **Choose the incorrect relationship of bond energies**

A. Br – Br > I – I

B. Cl – Cl > F – F

[✓ C. C ≡ C > N ≡ N]

D. All are correct

Q.37 **The S.I unit of dipole moment is**

A. Debye

B. pm

[✓ C. mC]

D. Both A and B

Q.38 **Which of the following molecules has non-zero dipole moment.**

[✓ A. CH_3Cl]

B. BF_3

C. CO_2

D. CCl_4

Q.39 **Maximum dipole moment is possessed by**

[✓ A. H_2O]

B. H_2S

C. CO

D. CH_4

Q.40 **The experimentally determined bond length of C—Cl is 176.7pm and C—C is 154pm what would be the radius of Cl atom**

A. 22.7pm

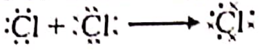
[✓ B. 99.7pm]

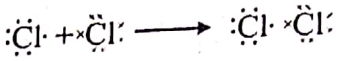
C. 176.7pm

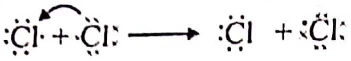
D. 330.7pm

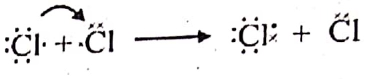
PAST PAPER QUESTIONS

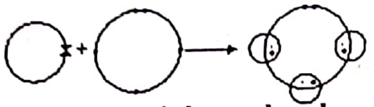
Q.1 **Which one of the following is the correct dot and cross diagram of bonding between two chlorine atoms** **MDCAT (2015)**

A. 

[✓ B. ]

C. 

D. 

Q.2 

MDCAT (2016)

Choose the right molecule

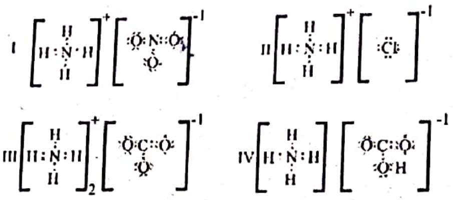
A. CH_3

B. H_2O

C. CO

[✓ D. NH_3]

Q.3 **Observe the given dot and cross structures for the following molecules or ionic species.** **MDCAT (2017)**



The co-ordinate covalent bond exists between:

A. N and C atoms in structure III and IV

[✓ B. N and one H ion in all four structure]

C. N and Cl atoms of structure II

D. N and N atoms of structure I

Q.4 **According to Valence shell electron pair repulsion theory, the repulsive forces between the electron pairs of central atom of a molecule are in the order** **MDCAT (2013)**

A. Lone pair bond pair> Lone pair-Lone pair

B. Bond pair> Bond pair> Lone pair-Lone pair> Lone pair-Bond pair

C. Lone pair-Bond pair> Bond pair-Bond pair> Lone pair-Lone pair.

[✓ D. Lone pair-Lone pair>Lone pair-Bond pair>Bond pair-Bond pair]

Q.5 **What is the exact value of angle in BF_3** **MDCAT (2017)**

A. 90°

B. 104.5°

C. 119.5°

[✓ D. 120°]

Q.6 **Which option show all the molecules with bond angle 109.5°.** **MDCAT (2018)**

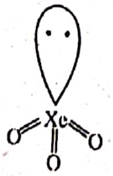
[✓ A. $SiCl_4$, NH_4^+, CH_4]

B. $SiCl_4$, H_2O, $BeCl_2$

C. CH_4, CCl_4, NH_3

D. CH_4, NH_4^+, PH_3

Q.7 **The structure of Xenon trioxide is shown below,**



With reference to the Valence shell electron pair repulsion theory, (VSEPR), the shape of XeO_3 is: **MDCAT (2019)**

A. Tetrahedral

[✓ B. Trigonal pyramidal]

C. Bent (or angular)

D. Trigonal planar

Q.8 **Which of the following sets constitutes of all the molecules and ions of non-planar geometry?** MDCAT (2019)

A. $SO_2, C_2H_4, BF_3, NO_3^-$
[✓ B.] $CH_4, NH_4^+, MnO_4^-, NF_3$
C. $CH \equiv CH, H_2O, BeCl_2, H_2S$
D. PH_4^+, NH_3, SO_3, Benzene

Q.9 **The shape of CO_2 molecule is similar to** NUMS (2019)

A. H_2S
B. SO_2
C. $SnCl_2$
[✓ D.] BeF_2

Q.10 **What is the shape of ammonia NH_3 molecule?** SET (2019)

[✓ A.] Pyramidal
B. Linear
C. Tetrahedral
D. Trigonal planar

Q.11 **The number of bonds in nitrogen molecule is** MDCAT (2010)

A. One σ and one π
B. Three σ only
[✓ C.] One σ and two π
D. Two σ and one π

Q.12 **When the two partially filled atomic orbital overlap in such a way that the probability of finding the electron is maximum around the line joining the two nuclei, the result is the formation of** MDCAT (2014)

[✓ A.] Sigma bond
B. Hydrogen bond
C. Pi-bond
D. Metallic bond

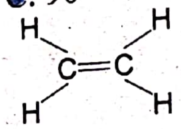
Q.13 **pi- bond is formed by sideways overlap of** MDCAT (2017)

A. s-orbital
B. d-orbital
[✓ C.] p-orbital
D. None of these

Q.14 **The angle between un-hybridized p-orbital and three sp^2 hybrid orbitals of each carbon atom is** MDCAT (2012)

A. 120°
B. 109.5°
[✓ C.] 90°
D. 180°

Q.15



Count the number of σ bonds and π bonds in the molecule MDCAT (2016)

[✓ A.] 1π and 5σ bonds
B. 3π and 3σ bonds
C. 2π and 4σ bonds
D. 6π and 6σ bonds

Q.16 **Which if the following molecule has largest number of shared pair electrons?** MDCAT (2018)

A. NH_3
B. CO_2
[✓ C.] C_2H_4
D. N_2

Q.17 **Which one of the following molecules has sp^3 hybridization?** MDCAT (2019)

[✓ A.] CH_4
B. C_2H_2
C. C_2H_4
D. CO_2

Q.18 **According to the Lewis Concept, ammonia is a lone pair donor, therefore easily accepts a proton to form an ammonium ion as given by an equation** SET (2019)

$$NH_{3(g)} + H^+_{(aq)} \longrightarrow NH^+_{4(aq)}$$

A. H–N–H bond angle decrease from 180°-109.5°
B. H–N–H bond angle decrease from 107°-104.5°
[✓ C.] H–N–H bond angle increase from 107°-109.5°
D. H–N–H bond angle decrease from 109.5°-120°

Q.19 **Which of the following molecule has zero dipole moment?** NUMS (2019)
A. PCl_3
[✓ B. BF_3]
C. NH_3
D. H_2O

Q.20 **Which one of the following has zero dipole moment:** MDCAT (2010)
A. NH_3
B. H_2O
C. $CHCl_3$
[✓ D. BF_3]

Q.21 **Among the following molecules, which one has coordinate covalent (dative) bond?** SET (2019)
A. CCl_4
[✓ B. CO]
C. CO_2
D. CH_4

Q.22 **Which of the following molecule has zero dipole moment?** NUMS (2019)
A. PCl_3
B. BF_3
[✓ C. NH_3]
D. H_2O

Q.23 **For formation of ionic bond, electronegatively difference should be** NUMS (2019)
A. Equal to zero
[✓ B. Equal to 0.5]
C. More then 1.7
D. Less than 1.7

Q.24 **The ionization energy of hydrogen atom is:** MDCAT (2010)
A. Zero
B. 131.3kJmole
C.13.13kJ/mole
[✓ D. 1313kJ/mole]

Q.25 **The elements for which the value of ionization energy is low can** MDCAT (2011)
A. Gain electrons readily
B. Gain electrons with difficulty
C. Lose electron less readily
[✓ D. Lose electron readily]

Q.26 **Electron affinity of the atom is the energy released when** MDCAT (2018)
[✓ A. Electron is added to gaseous atom]
B. Electron is removed from gaseous atom
C. Covalent bond of molecule is broken
D. Cov. bond is formed between the atoms

Q.27 **The shielding effect of inner electron is responsible for:** NUMS (2019)
[✓ A. Decreasing ionization energy]
B. Having no effect on ionization energy
C. Increasing ionization energy
D. Increasing electronegativity

Q.28 **What will be the shape of a molecule which contains two sigma bond pairs and one lone pair?** ETEA (2016)
A. Linear
[✓ B. V shape]
C. Tetragonal
D. Triangular

Q.29 **A molecule which contains two lone pairs and two bond pairs of electrons in valence shell of central atom, geometrical shape of molecules will be** ETEA (2019)
A. Tetrahedral
B. Trigonal pyramidal
[✓ C. Angular]
D. Linear

Q.30 **Fe^{+2} will from the most ionic bond with** ETEA (2019)
A. N^{-3}
B. SN^{-3}
C. P^{-3}
[✓ D. F^{-1}]

Q.31 **Which of the following elements has lowest first ionization energy?** ETEA (2019)
A. N
B. O
C. C
[✓ D. B]

Q.32 Which one of the following elements has the largest second ionization energy? ETEA (2019)

A. O
B. F
●. Na
D. N

Q.33 Which equation relates to the fist ionization energy of bromine? ETEA (2019)

A. $Br_{(g)} \rightarrow Br^{-}_{(g)} + 1e^{-}$
●. $Br_{(g)} \rightarrow Br^{+}_{(g)} + 1e^{-}$
C. $\frac{1}{2}Br_{2(g)} \rightarrow Br^{-}_{(g)} + 1e^{-}$
D. $\frac{1}{2}Br_{2(g)} \rightarrow Br_{g} + 1e^{-}$

Q.34 The bond angle in H_2S is less than H_2O. It is due to ETEA (2019)

A. Small size of oxygen atom
●. Greater E N of oxygen atom
C. Oxygen contain two lone pairs of electrons
D. All of the above

Q.35 In the second period of elements, although oxygen lies next to nitrogen yet its ionization first energy is lower than that of nitrogen because? MDCAT (2019)

●. In oxygen, there exists repulsion between pair of electrons present in the same orbital of valence shell
B. Oxygen is paramagnetic in character.
C. Nuclear charge of oxygen is greater than nitrogen.
D. Oxygen has higher electron affinity.

Q.36 Nitrogen has the atomic mass of 7. Which of the following electronic configurations is of a Nitrogen atom in ground state? MDCAT (2019)

●. $1s^2, 2s^2, 2px^1, 2py^1, 2pz^1$
B. $1s^2, 2s^2, 2py^2, 2pz^1$
C. $1s^2, 2s^2, 2px^2, 2py^1$
D. $1s^2, 2s^2, 2px^2, 2pz^1$

Q.37 Which of the following has the highest value of electronegativity? NMDCAT (2020)

A. I
B. Br
C. Cl
●. F

Q.38 Which of the following hybrid orbital have maximum s-character? NMDCAT (2020)

A. sp^3
B. sp^2
●. sp
D. dsp^2

Q.39 The first ionization energy is maximum for NMDCAT (2020)

A. Na
●. Mg
C. Al
D. K

ANSWER KEY

1	C	11	D	21	A	31	C
2	B	12	B	22	A	32	C
3	A	13	A	23	D	33	B
4	D	14	C	24	C	34	D
5	D	15	D	25	A	35	D
6	C	16	B	26	A	36	C
7	D	17	C	27	C	37	C
8	C	18	D	28	B	38	A
9	D	19	B	29	C	39	A
10	B	20	B	30	D	40	B

PAST PAPER QUESTIONS

1	B	6	A	11	C	16	C	21	B	26	A	31	D	36	A
2	D	7	B	12	A	17	A	22	C	27	A	32	C	37	D
3	B	8	B	13	C	18	C	23	B	28	B	33	B	38	C
4	D	9	D	14	C	19	B	24	D	29	C	34	B	39	B
5	D	10	A	15	A	20	D	25	D	30	D	35	A		

EXPLANATORY NOTES

Q.1 Ionic size decreases along the period form left to right. More over anions are of larger size as compare to cations. So, order of ionic radius is $N^{-3} > O^{-2} > F^{-1} > Na^{+1}$

Q.2 Atomic radius decreases along the period due to Increasing effective nuclear charge.

Q.3 $A^{2-} > A^{-} > A > A^{+} > A^{2+}$

Q.4

$$\text{I.E} \,\alpha\, \frac{1}{\text{atomic size}} \,\alpha\, \frac{1}{\text{shielding effect}} \,\alpha\, \frac{1}{\text{effective nuclear charge}}$$

It also depends on nature of orbital in this order

$s > p > d > f$

Q.5 Ionization energy is directly related to the stability of electronic configuration. helium has highest value in the table

Q.6 Down the group ionization energy decreases due to increase in number of shell, shielding effect and atomic size.

Q.7 Ionization energy is directly related to the stability of electronic configuration. ns^2, nsp^6 has already complete octet. Group VIIIA has highest I.E value among all groups

Q.8 Generally electron affinity increases from left to right along the period and the groups VIIA elements have highest values of 1st electron affinities.

Q.9 Electron affinity is inversely to the stability of electronic configuration.

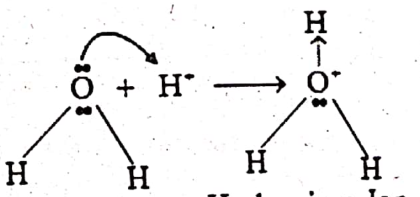
Q.10 Ionic compound is formed between the two atoms when one of them has low ionization energy and other have high electron affinity.

Q.11 Metals of group IA and IIA have low ionization energy means highly electropositive character and great tendency to form ionic bond.

Q.12 Strength of ionic character depends upon electronegativity difference. CsF as greatest electronegativity difference of 3.3 and maximum ionic character of 92 %

Q.13 Dative bond is formed when shared pair of electrons is provided by only one atom. In case of OH^- there is no donor– accepter relationship.

Q.14 Hydronium ion has two covalent bonds and one dative bond.



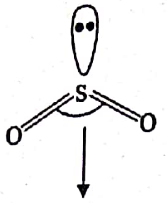
Hydronium Ion

Q.15 BF_4^- and NH_4^+ both have 3 covalent bonds and 1 co-ordinate covalent bond in their structure. Hence out of total 4 bonds 1 is co-ordinate covalent and each bond have 25% co-ordinate covalent character. (%age of dative bond $= 1\times100/4 = 25\%$)

Q.16 Electronegativity difference as an index to bond nature:

- The bond between two atoms is non-polar covalent if electronegativity difference between them is zero or less than 0.5.
- The bond between two atoms is polar covalent if electronegativity difference between them is 0.5 to 1.6.
- The bond between two atoms is equally covalent and ionic if electronegativity difference is 1.7.
- The bond is ionic if E.N difference is greater than 1.7

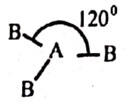
Q.17 SO_2 is AB_3 (AB_2L) type with 2 bond pairs and one lone pair



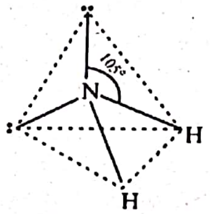
Less than 120°
Bent / angular, SO_2

Q.18 PCl_3 resembles NH_3 molecule. Both P and N belong to group VA and have one lone pairs of electrons in these molecules.

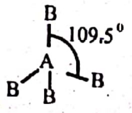
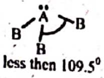
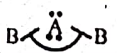
Q.19 BF_3 and AlH_3 are trigonal planar because each has three bond pairs only AB_3 type



Q.20 NH_2^{-1} is AB_4 (AB_2L_2) type with two lone pairs and two bond pairs. Its shape is bent or angular.

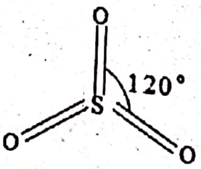


Q.21

Type	Electron Pairs			Arrangement of electron pairs	Molecular geometry	Shape	Examples
	Total	Bonding	Lone				
AB_4	4	4	0	Tetrahedral	Tetrahedral		CH_4, $SiCl_4$, CCl_4, BF_4^- NH_4^+, SO_4^{-2}
		3	1		Trigonal pyramidal	 less then 109.5°	NH_3, NF_3 PH_3
		2	2		Bent (or angular)	 less then 109.5°	H_2O, H_2S

Q.22 $CH_4(109^o) > H_2O(104^o) > NF_3(102^o) > H_2S(92^o)$

Q.23 SO_3 is AB_3 type with three bond pairs only



Triangular planar

Q.24 Paramagnetic behaviour of oxygen is explained by MOT.

Q.25 End to end overlapping of orbitals is axial overlapping and is linear which results in sigma bond.

Q.26 π-bonds are formed by parallel overlapping of un-hybrid orbitals

Q.27 VBT does not explain valencies other than ground state.

Q.28 Electronic Configuration of $_{17}Cl$ $1s^2, 2s^2, 2p^6, 3s^2, 3p^2_x, 3p_y^2, 3p_z^1$

Q.29 The process in which the orbitals of different energies and shape mix with each other to give equivalent hybrid orbitals is called hybridization.

Q.30 In NO_3^- the central atom N is sp^2 hybridized.

Q.31 Ground state configuration of $_6C = 1s^2, 2s^2, 2p^1_x, 2p_y^1, 2p_z^0$

Q.32 Phosphorous can make up to five covalent bonds as in PCl_5.

Q.33 %ionic character is directly related to electronegativity difference.

Q.34 Dipole moment gives the information about:

- % ionic character
- Bond angles
- Geometry of the molecules

Q.35 Generally, $B.L \propto$ p character $\propto$ atomic radius $\propto \dfrac{1}{\text{Ionic character}}$

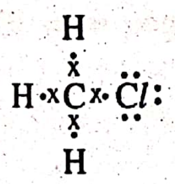
Q.36 Atomic size of N < C. so BE of $N\equiv N = 941$ kJ/mol and BE of $C\equiv C = 839$ kJ/mol

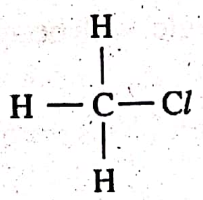
$$\text{Bond energy} \propto \frac{1}{\text{atomic size}}$$

Q.37 $\mu = q \times r,\ q = \text{coulumb},\ r = \text{meter}$

The S.I unit of dipole moment is mC

Q.38 CH_3Cl is a polar molecule and has non-zero dipole moment due to polarity between C and Cl





Q.39 H_2O is most polar in given options Δ electronegativity between H and O is higher among given cases. H_2O ($\mu = 1.85D$., CO ($\mu = 0.12D$., H_2S ($\mu = 0.95D$. CH_4 ($\mu = 0.0D$.

Q.40 Bond length (BL)= $r_C + r_{Cl}$.

$r_{Cl} = BL - r_C = 176.7 - 77 = 99.7$pm

EXPLANATORY NOTES

(PAST PAPER QUESTIONS)

Q.1 Cl has 3 lone pair and share one electron for the formation of covalent bond.

Q.2 The structure of molecule indicates 3 bond pair and one lone pair so it must be NH_3.

Q.3 In the molecule of NH_3 it has a lone pair and shares its lone pair with Hydrogen ion.

Q.4 According to VSEPR lone pair occupies more space than bond pair so order of repulsion is l.p-l.p> b.p-l.p > b.p – b.p

Q.5 BF_3 belongs to AB_3 type so it will have 120° bond angle

Q.6 $SiCl_4$, NH_4^+, CH_4 all belongs to AB_4 type with no lone pair so it will have 109.5° bond angle

Q.7 XeO_3 belongs to AB_3E system so it will have trigonal pyramidal geometry.

Q.8 NF_3,MnO_4^-,CH_4 , NH_4 all the given species have sp^3 hybridization that's why they will have non planar geometry.

Q.9 CO_2 and BeF_2 both have AB_2 type and linear geometry.

Q.10 Ammonia belongs to AB_3E type.It has trigonal pyramidal geometry.

Q.11 Nitrogen molecule is a triple bonded molecule it has one sigma and 2 pi bonds.

Q.12 Head on overlap always produces sigma bond while sidewise overlap produces pi bond.

Q.13 s orbital and hybrid orbital always forms sigma bond while p can form both sigma and pi bond. When it overlaps sidewise p will form pi bond.

Q.14 Unhybrid and hybrid orbitals are always present perpendicular to one another so bond angle will be 90°

Q.15 Ethene molecule has total 5 sigma bonds (4 C-H , 1 C-C) while one pi bond.

Q.16 Ethene molecule has total 5 sigma bonds (4 C-H , 1 C-C) while one pi bond. It has maximum number of bonds as compared to others that's why it will have maximum number of shared electrons.

Q.17 In Methane Carbon atom is forming 4 Covalent bonds, for that reason it has coordination number 4 so its hybridization will be sp^3

Q.18 When Ammonia forms ammonium ion its bond angle will be changed from 107.5° to 109.5°

Q.19 BF_3 has no lone pairs on central atom for that reason it has zero dipole moment and is non-polar molecule.

Q.20 BF_3 has no lone pairs on central atom for that reason it has zero dipole moment and is non-polar molecule.

Q.21 CO molecule has Coordinate covalent bond. $:C\overset{\longleftarrow}{=}\ddot{O}$

Q.22 BF_3 has no lone pairs on central atom for that reason it has zero dipole moment and is non-polar molecule.

Q.23 Electro negativity difference as an index to bond nature:

- The bond between two atoms is non-polar covalent if electronegativity difference between them is zero or less than 0.5.
- The bond between two atoms is polar covalent if electronegativity difference between them is 0.5 to 1.6.
- The bond between two atoms is equally covalent and ionic if electronegativity difference is 1.7.
- The bond is ionic if E.N difference is greater than 1.7

Q.24 Ionization energy of Hydrogen atom is 1313.31 kj/mol

Q.25 Ionization energy is inversely proportional to ease of removal of electron. If I.E is low it can easily lose the electron.

Q.26 Electron affinity is the amount of energy released when an electron is added in gaseous atom.

Q.27 Down the group ionization energy decreases due to increase in number of shell, shielding effect and atomic size.

Q.28 PCl_3 resembles NH_3 molecule. Both P and N belong to group VA and have one lone pairs of electrons in these molecules they have trigonal pyramidal geometry.

Q.29 (AB_2E_2) type with two lone pairs and two bond pairs. Its shape is bent or angular.

Q.30 Metallic cation combines with most Electronegative atom like F^{-1} to form most ionic bond.

Q.31 Order of Ionization energy is given N> O> C> B

Q.32 Na after losing one electron gains the configuration of noble gas. Now to remove second electron from noble gas configuration requires greater amount of energy.

Q.33 Ionization energy is the amount of energy required to remove electron from gaseous isolated atom to form a gaseous cation.

Q.34 Electronegativity of O is more than S. Electronegtivity of central atom is directly proportional to bond angle, that is why H_2S has 92° while H_2O has 104.5°

Q.35 Nitrogen has $2s^2\ 2p^3$ valence shell configuration while Oxygen has $2s^2\ 2p^4$ valence shell configuration. As Nitrogen has more stable valence shell configuration that is why to remove electron from nitrogen is difficult that is why nitrogen has high Ionization energy.

Q.36 XeO_3 belongs to AB_3E system so it will have trigonal pyramidal geometry.

Q.37 In methane carbon atom is forming 4 covalent bonds, for that reason it has coordination number 4 so its hybridization will be sp^3

Q.38 Ground state configuration of ${}_7N = 1s^2, 2s^2, 2p^1_x, 2p_y^1, 2p_z^1$

Q.39 NF_3, MnO_4^-, CH_4, NH_4^+ all the given species have sp^3 hybridization that's why they will have non planar geometry.

Q.40 Order of electronegativity is F> Cl> Br> I

Q.41 % s character in different hybridization is given

sp^3 has 25% s character

sp^2 has 33.3% s character

sp has 50% s character

Q.42 Mg has most stable electronic configuration that's why it has highest ionization energy

Topic 11

S AND p BLOCK ELEMENTS

PRACTICE EXERCISE

Q.1 **Which of the following represent elements in order of decreasing atomic size?**
A. F, Cl, Br
[✓ B. Li, Be, B]
C. S, P, Si
D. Be, Mg, Ca

Q.2 **Which of the following will remain constant along the period**
A. Atomic size
B. Atomic number
[✓ C. Shell number]
D. Ionization energy

Q.3 **The correct order of atomic radii is**
A. $F < K < Na < Li$
[✓ B. $F < Li < Na < K$]
C. $Li < Na < K < F$
D. $Na < K < Li < F$

Q.4 **Increase in atomic size down the group is due to**
A. Addition of shells
B. Shielding effect
C. Inert pair effect
[✓ D. Both A. and B.]

Q.5 **Atomic radius of fluorine is only larger than ______ in its period**
A. Li
B. O
C. N
[✓ D. Ne]

Q.6 **Which one of the following is smallest in size?**
[✓ A. Na^+]
B. O^{2-}
C. F^-
D. N^{3-}

Q.7 **Consider the iso-electronic species, K^+, S^{2-}, Cl^- and Ca^{2+}, the radii of the ion decrease as**
A. $Ca^{+2} > Cl^- > K^+ > S^{2-}$
B. $K^+ > Cl^- > Ca^{2+} > S^{2-}$
C. $Cl^- > K^+ > S^{2-} > Ca^{2+}$
[✓ D. $S^{2-} > Cl^- > K^+ > Ca^{2+}$]

Q.8 **The radius of fluorine atom is 72pm and that of the fluoride ion (F^-) is ______**
A. 72pm
B. 44pm
[✓ C. 133pm]
D. 36pm

Q.9 **One of the following species is iso-electronic with Ca^{2+}. Which is that**
A. Sr^{2+}
B. Na
[✓ C. Ar]
D. Mg^{2+}

Q.10 **The radii of H, H^+ and H^- are in the order of**
A. $H^+ > H > H^-$
B. $H > H^- > H^+$
[✓ C. $H^- > H > H^+$]
D. $H > H^+ > H$

Q.11 **The ionization energy of an element is**
A. The energy released when an electron is added to an atom of the element
[✓ B. The same as the electron affinity of element]
C. Equal in magnitude but of opposite sign to the electron affinity of the element
D. The energy required to remove the outermost electron of an atom of the element

Q.12 **The 1st ionization energy of metal is lower and 2nd ionization energy is very high, it indicate that group number is**
[✓ A. IA]
B. IIA
C. IIIA
D. IVA

Q.13 **The greater 1st ionization energy would be associated with which of the following configuration**
A. $1s^2\ 2s^2\ 2p^6\ 3s^1$
B. $1s^2\ 2s^2\ 2p^3$
C. $1s^2\ 2s^2\ 2p^5$
[✓ D. $1s^2\ 2s^2\ 2p^6$]

Q.14 **Which one of the following series is arranged in order of increasing value**
[✓ A. The first ionization energies of: Oxygen, Fluorine, Neon]
B. The radii of: H^- ion, H atom, H^+ ion
C. The electro negativities of: Chlorine, Bromine, Iodine
D. The boiling points of: Iodine, Bromine, Chlorine

Q.15 In the periodic table, the ionization energy of elements decreases from top to bottom because of

[✓ A. Increase in atomic size]
B. Decrease in electronegativity
C. Decrease in shielding effect
D. Increase in density

Q.16 In the following, the element with the highest ionization energy is

A. [Ne] $3s^2 3p^1$
B. [Ne] $3s^2 3p^2$
[✓ C. [Ne] $3s^2 3p^3$]
D. [Ne] $3s^2 3p^4$

Q.17 The unit of ionization energy is

A. Joule
B. Calorie
[✓ C. KJ/mol]
D. KJ

Q.18 Which of the following is NOT true about electronegativity

A. Metal has EN value less than 2
B. It has no unit
[✓ C. With increase in O.S, EN decreases]
D. It determines the polarity of molecule

Q.19 The power of an atom to attract shared pair of electrons towards itself in a molecule is called

A. Electron Affinity
[✓ B. Electronegativity]
C. Ionization Potential
D. Hydration Energy

Q.20 Which one of the following elements has greater electronegativity value

A. N
B. Br
[✓ C. O]
D. C

Q.21 Which of the following periodic properties has no unit

A. Electron Affinity
[✓ B. Electronegativity]
C. Ionization Potential
D. Hydration Energy

Q.22 Which statement is correct

A. Loss of valence electron may lead to loss of valence shell
B. Radius of isoelectronic ions decreases left to right in 3rd period
C. Anionic radius increase with magnitude of negative charge
[✓ D. All of these]

Q.23 Which of the following element has greater negative first electron affinity (EA_1)

[✓ A. C]
B. Li
C. B
D. Be

Q.24 Which of the following group of elements have positive 1st electron affinity

A. IA
B. VIA
[✓ C. IIA]
D. VIIA

Q.25 Which of the following halogens has comparatively smaller first electron affinity

A. F
[✓ B. I]
C. Br
D. Cl

Q.26 Melting points of group IIA elements are considerably higher than those of group IA elements because

A. Size of IIA is greater than IA
B. I.E of IIA is higher than IA
C. I.E of IIA is less than IA
[✓ D. IIA provide more binding electron]

Q.27 The lowest melting point among these four elements is of

A. Be
B. Ca
[✓ C. Mg]
D. Sr

Q.28 The highest melting point among these elements is of

[✓ A. Nitrogen]
B. Fluorine
C. Oxygen
D. Neon

Q.29 Generally the melting point decreases from VA to VIII A along the period but with exception of

A. Phosphorous

B. Chlorine

[✓ C. Sulphur]

D. Argon

Q.30 Among the given elements of period 3, the highest value of melting point is observed in case of

A. Mg

[✓ B. Si]

C. Al

D. P

Q.31 Correct order of melting point of group II A elements

A. Be > Mg > Ca

B. Ca > Be > Mg

C. Mg > Be > Ca

[✓ D. Be > Ca > Mg]

Q.32 In which group melting and boiling point decreases down the group

[✓ A. IA]

B. VIIA

C. VIIIA

D. VA

Q.33 The element which has boiling point less than 0°C is

A. Beryllium

B. Carbon

C. Boron

[✓ D. Nitrogen]

Q.34 Which of the following is incorrect information

A. Metals have free electrons in the valence shell

[✓ B. Electrical conductivity of metals increases with the increase of temperature]

C. Metalloids are poor conductors of electricity

D. Non-metals have atomic conductance usually less than 10^{-10} ohm^{-1}

Q.35 Which of the following group of elements have extra ordinary high value of electrical conductivity

A. IA

[✓ B. IB]

C. IIA

D. VIIA

Q.36 Which one of the following alkali metals forms only normal oxide when it reacts with O_2

[✓ A. Lithium]

B. Sodium

C. Potassium

D. Rubidium

Q.37 The elements of group I-A react violently with water and make the solution

A. Neutral

B. Amphoteric

C. Acidic

[✓ D. Alkaline]

Q.38 What is the nature of reaction $Li_2O + H_2O \longrightarrow 2LiOH_{(aq)}$

A. Decomposition

B. Acid-base

C. Redox

[✓ D. All of these]

Q.39 Which of the following metal can form peroxide with Oxygen

[✓ A. Ba]

B. Li

C. Mg

D. All of these

Q.40 Which one of the following doesn't react with water even at red hot temperature

[✓ A. Be]

B. Mg

C. Ca

D. Ba

PAST PAPER QUESTIONS

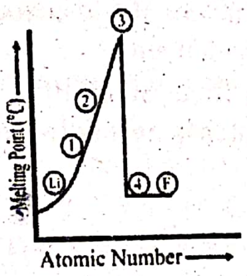
Q.1 Energy required to remove an electron from gaseous neutral atom is:MDCAT (2010)

[✓ A. Electron affinity]
B. Lattice energy
C. Ionization energy
D. Crystal energy

Q.2 The elements for which the value of ionization energy is low can MDCAT (2011)

A. Gain electrons readily
C. Lose electron less readily
B. Gain electrons with difficulty
[✓ D. Lose electron readily]

Q.3 The diagram below is a plot of melting points of elements of second period against their atomic numbers. Lithium and fluorine are placed at the extreme ends of the plot. On the basis of melting points where would you place carbon among the empty slots on the plot? MDCAT (2011)



A. 1
B. 4
C. 2
[✓ D. 3]

Q.4 Which one remains same along a period? MDCAT (2012)

A. Atomic radius
[✓ B. Number of shells (orbits)]
C. Melting point
D. Electrical conductivity

Q.5 More the ionization energy of an element MDCAT (2012)

A. More the electro positivity
[✓ B. Less the metallic character]
C. More the reducing power
D. Bigger the atomic radius

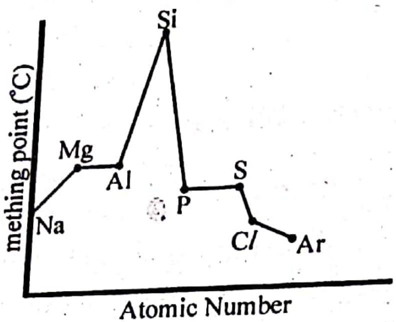
Q.6 Along a period, atomic radius decreases. This gradual decrease in radius is due to: MDCAT (2013)

A. Increase in number of shells
[✓ B. Increase in number of protons in the nucleus]
C. Melting and boiling points first decrease then increase
D. Melting and boiling points first increase then decrease

Q.7 What is the trend of melting and boiling points of the elements of short periods as we move from left to right in a periodic table? MDCAT (2013)

A. Melting and boiling points decrease gradually
B. Melting and boiling points first decrease then increase
C. Melting and boiling points increase gradually
[✓ D. Melting and boiling points first increase then decrease]

Q.8 The trends in melting points of the elements of 3rd period are depicted in figure below **MDCAT (2014)**



The sharp decreases observed from 'Si' to 'P' is due to

A. Decrease in atomic radius from 'Si' to 'P'
B. Change in bonding and structure of two elements
C. Different densities of two elements
D. Increase in electron density from 'Si' to 'P'

Q.9 **Arrange the following elements according to the trends of ionization energies C, N, Ne, B** **MDCAT (2014)**

A. Ne < N < C < B
B. B < C < N < Ne
C. B < N < C < Ne
D. Ne < B < C < N

Q.10 **Keeping in view the size of atoms, which order is correct?** **MDCAT (2015)**

A. N > C
B. Ar > Cl
C. P > Si
D. Li > Be

Q.11 **Which one of the following will have the smallest radius?** **MDCAT (2015)**

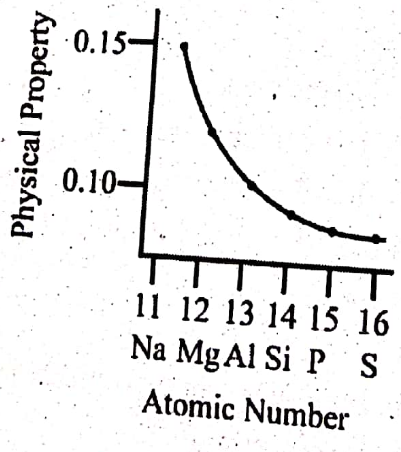
A. Al^{+3}
B. Mg^{+2}
C. Si^{+4}
D. Na^{+1}

Q.12 **The ionic radius of fluoride ion is:** **MDCAT (2016)**

A. 72 pm
B. 136 pm
C. 95 pm
D. 157 pm

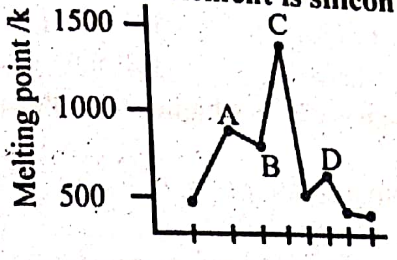
"Actual value of ionic radius of fluoride ion is **133 pm**"

Q.13 **Following graph shows a physical property along the period 3 elements. Which physical property is** **MDCAT (2017)**



A. Electron affinity
B. Non-metallic character
C. Atomic radius
D. Melting point up to group IVA

Q.14 **The following sketch shows the melting point of eight elements with consecutive atomic numbers. Which element is silicon?** MDCAT (2017)



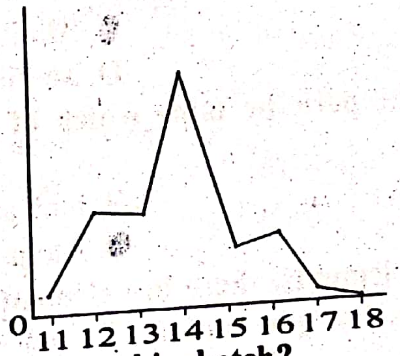
A. A [✓ B. C]
C. B D. D

Q.15 **Ionic radius along the period decreases due to:** MDCAT (2017)
A. Addition of a new shell B. High Ionization energy
[✓ C. Increase in nuclear charge] D. Decrease in nuclear charge

Q.16 **Down the group acid-base behavior of metallic oxides of group 2 elements changes to** MDCAT (2018)
[✓ A. More basic] B. No change
C. Less basic D. More acidic

Q.17 **In period 2 and period 3 maximum melting point shown by elements** MDCAT (2018)
A. Lithium and sodium [✓ B. Carbon and silicon]
C. Neon and argon D. Nitrogen and phosphorous

Q.18 **The following sketch show the variation in a physical property of third period elements against their number:**



MDCAT (2018)

What physical property is plotted in this sketch?
A. Ionic radius [✓ B. Melting point]
C. Ionization energy D. Atomic radius

Q.19 **The strongest acid among the following is:** MDCAT (2010)
A. HF B. HBr
C.HCl [✓ D. HI]

Q.20 **When the elements of group 2A are exposed to air, they quickly become coated with layer of oxide. What is the purpose of this oxide layer** MDCAT (2011)
A. The oxide layer exposes the metal to atmospheric attack
B. The oxide layer increases the reactivity of metal
[✓ C. The oxide layer protects the metal from further attack]
D. No layer forms

Q.21 **Alkaline earth metal hydroxides decompose on heating. Which of the following reactions is a correct representation of this decomposition?** **MDCAT (2012)**

[✓ A. $M(OH)_{2(s)} \longrightarrow MO_{(s)} + H_2O_{(l)}$]
B. $2MOH_{(s)} \longrightarrow 2MO_{(s)} + H_2(g)$
C. $MOH_{(s)} \longrightarrow M_2O_{(s)} + H_2O_{(l)}$
D. $4MOH_{(s)} \longrightarrow 4M_{(s)} + H_2O_{(l)} + O_{2(s)}$

Q.22 **Melting points of group II-A elements are higher than those of group I-A because:** **MDCAT (2016)**

A. Atoms of II-A elements have smaller size
B. II-A elements are more reactive
[✓ C. Atoms of II-A elements provide two binding electrons]
D. I-A elements have smaller atomic radius

Q.23 **Among the following, which one is least reactive metal:** **MDCAT (2017)**

A. Mg
B. Na
C. Ca
[✓ D. Be]

Q.24 **Melting point of Na & Mg decreases down the group due to:** **MDCAT (2017)**

A. Strong electronegativity
[✓ B. Increment in size]
C. Strong attractive forces
D. High Ionization energy

"This is actual question given in MDCAT but statement of this question should be
"Melting point of Na & Mg **"GROUP"**decreases down the group due to"

Q.25 **Which element has the highest electron affinity among halogens?** **SET (2019)**

A. F
B. I
[✓ C. Cl]
D. Br

Q.26 **Which one of the following properties decreases across the third period of elements in the periodic table?** **SET (2019)**

A. Electronegatively
[✓ B. Ability to act as reducing agent]
C. Ionization energy
D. Melting and boiling points

Q.27 **In the 3rd period of the periodic table which of following property is decreasing consistently?** **SET (2019)**

A. Electrical conductivity
B. Ionization energy
C. Melting point
[✓ D. Atomic radius]

Q.28 **In the third period of elements, there lies element "X" which is metallic in nature and it can reduce chlorine gas rapidly. To which group of elements does "X" belong?** **(SET 2019)**

A. IIA
B. VIIA
C. IVA
[✓ D. IA]

Q.29 **The hydration energy of Mg^{2+} is less than** **NUMS (2019)**

A. Na^{+1}
B. Ca^{2+}
C. Li^{+1}
[✓ D. Al^{3+}]

Q.30 **Which alkaline earth metal makes peroxides?** **NUMS (2019)**

[✓ A. Ba]
B. Be
C. Mg
D. Ca

Q.31 **Lithium reacts with air to form** **ETEA (2016)**

A. Li_2O
B. Li_3N
C. $Li_2O_2 + Li_2CO_3$
[✓ D. Both A and B]

Q.32 How many elements are there in the 3 period of periodic table? ETEA (2019)

A. 18
[✓ B. 8]
C. 32
D. 10

Q.33 Which oxides of "K" contain more oxygen than is normal oxide? ETEA (2019)

A. Peroxide
[✓ B. Super oxide]
C. Both contain equal quantity
D. None of the above

Q.34 Modern periodic table is arranged in ascending order of? MDCAT (2019)

A. Atomic mass
B. Mass number
C. Nucleon number
[✓ D. Proton number]

Q.35 Ionization energy decrease down the group from top to bottom due to: MDCAT (2019)

A. Decrease in atomic size
B. Increase in atomic mass
[✓ C. Increase in shielding effect of the intervening electrons]
D. Increase in proton number

Q.36 Oxidation number of particular element can be directly or indirectly inferred from its: MDCAT (2019)

A. Physical state
[✓ B. Group number]
C. Atomic size
D. Atomic mass

Q.37 Potassium, Rubidium, Cesium reacts with oxygen to form which types of oxides? NMDCAT (2020)

A. Peroxide
[✓ B. Superoxide]
C. Suboxide
D. Normal oxide

Q.38 Magnesium reacts with nitrogen to form NMDCAT (2020)

A. Mg_2N_2
[✓ B. Mg_3N_2]
C. MgN_2
D. MgN

Q.39 Densities of alkali metals are low due to NMDCAT (2020)

A. Weak intermolecular forces
[✓ B. Large atomic volume]
C. Smaller size
D. ns^1 configuration

ANSWER KEY

1	B	11	B	21	B	31	D
2	C	12	A	22	D	32	A
3	B	13	D	23	A	33	D
4	D	14	A	24	C	34	B
5	D	15	A	25	B	35	B
6	A	16	C	26	D	36	A
7	D	17	C	27	C	37	D
8	C	18	C	28	A	38	D
9	C	19	B	29	C	39	A
10	C	20	C	30	B	40	A

PAST PAPER QUESTIONS

1	A	6	B	11	C	16	A	21	A	26	B	31	D	36	B
2	D	7	D	12	B	17	B	22	C	27	D	32	B	37	B
3	D	8	B	13	C	18	B	23	D	28	D	33	B	38	B
4	B	9	B	14	B	19	D	24	B	29	D	34	D	39	B
5	B	10	D	15	C	20	C	25	C	30	A	35	C		

EXPLANATORY NOTES

Q.1 Atomic size decreases from left to right in period due to increase in effective nuclear charge so from Li to B atomic size decreases

Q.2 Shell no and shielding effect remain constant along period because.
Period No. = Shell No.
Shielding effect $\propto$ No. of shell

Q.3 F is on the extreme right side of periodic table so has smallest size while Li, Na and K are alkali metals having large size. Their size increases down the group so correct order of atomic size is $F < Li < Na < K$

Q.4 Atomic size increases down the group due to
(i) Increase in no. of shell
(ii) Increase in shielding effect
(iii) Decrease in effective nuclear charge

Q.5 Atomic size decreases from left to right in period due to increase in effective nuclear charge (Z_{eff}) so correct order of atomic size is $Li > N > O > F > Ne$

Q.6 $\text{Ionic radius} \propto \dfrac{1}{\text{Magnitude of + ve charge on cation}}$

Ionic radius $\propto$ Magnitude of –ve charge on anion
So, order of ionic radius is $N^{-3} > O^{-2} > F^{-1} > Na^{+1}$

Q.7 $\text{Ionic radius} \propto \dfrac{1}{\text{Magnitude of + ve charge on cation}}$ If number of shells are constant.

Ionic radius $\propto$ magnitude of –ve charge on anion
So, order of ionic radius is $S^{-2} > Cl^{-1} > K^{+1} > Ca^{+2}$

Q.8 Negative ions have larger radius than the parent neutral atom

Q.9 Atomic No = No. of electrons
$_{20}Ca = 20$ electrons,
$Ca^{+2} = 20 - 2 = 18$ electrons
$_{18}Ar = 18$ electrons

Q.10 Cationic radius > Atomic radius > Anionic radius

Q.11 The ionization energy of an element is the energy required to remove the outermost electron of an isolated gaseous atom of the element.

Q.12 If there is large gap between 1st and 2nd ionization energy (I.E). It contains one valence electron and it belongs to IA group.

Q.13 $1s^2, 2s^2, 2p^6$ has highest I.E due to its complete octet (noble gas)
It is configuration of noble gas (stable configuration) so it has very high 1st I.E.

Q.14 Ionization energy increases from left to right in period due to increase in effective nuclear charge (Z_{eff}) so order of ionization energy is $_8O < _9F < _{10}Ne$

Q.15 Ionization energy decreases from top to bottom in group due to

(i) Increase in atomic size

(ii) Increase in shielding effect

(iii)Decrease in effective nuclear charge (Z_{eff})

Q.16 $_{10}$[Ne] $3s^2$, $3p^3$ has highest I.E due to extra stability of half filled p-subshell (group V)

This element has half filled (stable) p-orbital. So,

stability of orbital $\propto$ ionization energy

Q.17 Unit of Ionization energy is kJ/mol or ev/mol.

Q.18 With the increase of OS of elements, EN increases as it is observed along the period.

Q.19 The power of an atom to attract shared pair of electrons towards itself in a molecule is called electronegativity.

Q.20 The decreasing order of electronegativity of some important elements is

$F > O > N > Cl > Br > I > S > C > H = P$

Q.21 Electronegativity is comparative value and has no unit.

Q.22 All given statements about atomic radii are correct

Q.23 Electron affinity generally increase along the period from left to right.

$Be < Li < B < C$

Q.24 Group-IIA elements have lower values of E.A due to their stable electronic configuration.

Q.25 Electron affinity decreases down the group. The correct for the halogens is

$Cl > Br > F > I$

Q.26 Melting / boiling point of metals (1A & IIA) depends on

(i) No. of binding electrons

(ii) Metallic structure

Binding energy $\propto$ no. of binding electrons

Binding energy $\propto$ melting and boiling point

Group (IIA) provide two electrons per atom for binding so have highest melting and boiling point than IA)

Q.27 Generally, in group (IIA), melting point decreases down the group so order of melting point Be > Ca > Sr > Ba > Mg

Abnormally, Mg has lowest melting point because of its hexagonal structure. It contains empty spaces so, less binding energy and less melting point

Q.28 London dispersion forces $\propto$ Size $\propto$ polarizability

LDF $\propto$ melting point

Among given options, nitrogen has large size, large polarizability and large LDF and high melting point.

Q.29 London dispersion forces $\propto$ Size $\propto$ polarizability

Sulphur exist in S_8 form while Phosphorous exist in P_4. Due to larger size Sulphur has high melting point than phosphorous

Q.30 In 3rd period, Si has highest melting point because in its crystal it provides four electron per atom for binding, so high binding energy and highest melting point

Q.31 In IA and IIA group, melting point decreases due to increases in size, less binding energy. IIA group has exceptional order Be > Ca > Sr > Ba > Mg

Q.32 In IA and II A group, melting point decreases down the group due to

(i) Increase in size

(ii) Decreases in binding energy

Q.33 N_2 exist as independent individual non-polar small molecule so has least inter – molecular forces (IMF) and lowest boiling point (boiling point of $N_2 = -196°c$.

Size $\propto$ Polarizability $\propto$ London Dispersion Forces

London Dispersion Forces $\propto$ boiling point

While others have giant structure, high binding energy and high boiling point

Q.34 Electrical conductivity decreases due to increase in temperature because bumping of electron increases which results in hindrance in flow of electrons.

Q.35 I-B elements are coinage metals (Cu, Au, Ag) and have high conductivity.

Q.36 Only Lithium burns in air to form normal oxide, while sodium forms peroxide and other alkali metals form superoxides.Li_2O(white solid).

$Li + O_2 \longrightarrow Li_2O$ (Lithium oxide)

Q.37 Group 1-A elements react violently with water and make the solution alkaline

$2Na + 2H_2O \longrightarrow 2NaOH + H_2$

Q.38 $\mathbf{Li_2O + H_2O \longrightarrow 2LiOH_{(aq)}}$

It is decomposition reaction, acid-base reaction and also redox reactions.

Q.39 Only Ba from group IIA can form peroxide at high temperature

$Ba + O_2 \xrightarrow{500-600°C} BaO_2$ (Barium peroxide)

Q.40 Beryllium does not react with water even at red hot temperature due to the formation of protective oxide layer on the surface.

EXPLANATORY NOTES

(PAST PAPER QUESTIONS)

Q.1 According to definition the minimum amount of energy required to remove the outermost shell electron from an isolated gaseous atom to form an isolated gaseous ion is called ionization energy.

Q.2 As ionization means loss of electrons, so low IE means electron are lost easily.

Q.3 As we move across the period (left to right) the melting point increase upto group IVA and decreases after that, since C is at the top of Group IV A, So C would be placed at slot 3 in the given plot.

Q.4 The physical properties of elements change from left to right in the period, but the number of shell remains same in a particular period.

Q.5 As ionization energy is index of metallic character, so it is inversely proportional to metallic character.

Q.6 Nuclear charge is number of protons, and as electrons are added in same shell across the period, the effective nuclear charge increase which results in decrease of atomic radius.

Q.7 As melting and boiling points of elements depend on number of valence electrons and structure, so in a period (across) it first increase upto group IVA and then decreases.

Q.8 The sharp decrease observed is due to number of valence electrons which is 4 for Silicon and the structure of Silicon which is macromolecule (tetrahedral arrangement).

Q.9 The ionization energy of elements increases across the period, so elements with less atomic number have lower IE in the period (no exceptional element is given in option).

Q.10 The atomic size decreases across period and increases down the group so Li with atomic number 3 is larger then Be with atomic number 4.

Q.11 The metals after losing electron form a cation with smaller radius, the cationic radius is inversely proportional to the magnitude of positive charge, so Si^{+4} (hypothetical ion) would have smallest radius.

Q.12 Fluorine a non-metal after gaining an electron would form a negative ion (anion), and it results in increase of radius due to decrease in effective nuclear charge. So, following the values from text it is noted that actual size of F-atom is 72pm and on formation of Fluoride ion it is increased to 136pm.

Q.13 Physical properties such as IE, EA and EN increase across the period but atomic radius decrease for the same. The graph shows a decreasing trend (which is atomic radius)

Q.14 The sharp peak observed is due to number of valence electrons which is 4 for Silicon and the structure of Silicon which is macromolecule (tetrahedral arrangement)

Q.15 Along the period, the electrons are added in the same shell, however the nuclear charge (number of protons) also increase which results in net increase in effective nuclear charge and therefore the atomic radius decrease.

Q.16 As we move down the group, ionization energy decrease and thus metallic character increase, as a result the basic character is enhanced for metallic oxides of group 2A.

Q.17 As we move across the period, the melting and boiling points increase up to group IVA therefore C in period 2 and Si in period 3 have maximum melting point.

Q.18 Physical properties such as IE, EA and EN increase across the period but atomic radius decrease for the same. However, the melting point increases upto group IVA but falls later on.

Q.19 HI is the strongest reducing acid, as it has least bond energy. The decreasing order of acidic strength of halogen acids is HI > HBr > HCl > HF

Q.20 Group 2A elements are less reactive as on exposure to atmospheric oxygen they form a layer of oxide which protects them from further reaction and attack.

Q.21 The alkaline earth metal hydroxides have general formula of $M(OH)_2$, which on thermal decomposition from respective metal oxide and water.

For example : $Mg(OH)_{2(s)} \longrightarrow MgO_{(s)} + H_2O_{(l)}$

Q.22 As melting point depends on number of binding electrons, so across the period the number of binding electrons increase upto group IV A

Q.23 The reactivity of metals is inversely related to IE, therefore the least reactive metal is the one with smallest radii and maximum IE ie, Be here.

Q.24 As we move down the group the size increases, in case of metals increase in size causes lowering of melting point.

Q.25 Among halogens the EA is highest for Cl, whereas due to small size and repulsion by valence electrons F has lesser EA.

Q.26 As oxidation state number increases across the period, the reducing power decreases

Q.27 Across the period the size of the atom decreases gradually.

Q.28 The reducing power of metals is high in start of any period, so group I A is best.

Q.29 The hydration energy is directly related to charge and inversely to size

Q.30 In Group II-A down the group reactivity increases and thus Ba can form peroxide

Q.31 Li reacts with oxygen of air and as well as nitrogen to form oxide and nitride.

Q.32 Since period 3 is short period, it has 8 elements

Q.33 Superoxide of potassium has formula KO_2, which has more oxygen than K_2O and K_2O_2

Q.34 Modern Periodic table is arranged according to increasing number of protons called atomic number.

Q.35 One of the main factors that is responsible for the decrease in IE value is the shielding effect by intervening electrons of inner shell.

Q.36 Oxidation number is apparent charge which may be equal to valency. The valency or oxidation number is therefore can be inferred from group number.

Q.37 As reactivity increases down the group, the ability of metals of group I-A increases to form superoxide. So K, Rb and Cs can form superoxide easily.

Q.38 When magnesium is heated at high temperature, it forms MgO along with nitride having formula Mg_3N_2

Q.39 As density is defined as ratio of mass to volume, therefore as volume increase density decreases. According to periodic table group I-A is placed at the beginning of each period, so they have large atomic volume hence low density.

Topic 12

TRANSITION ELEMENTS

PRACTICE EXERCISE

Q.1 **Which one possesses maximum number of unpaired electrons**
[✓ A. Mn^{2+}]
B. Fe^{3+}
C. Cu^{2+}
D. Both A. and B.

Q.2 **The location of transition elements is in between**
A. Lanthanides and actinides
[✓ B. s and p block elements]
C. Chalcogens and halogens
D. d and f block elements

Q.3 **The correct electronic configuration of 'Cr' is**
A. $[Ar]\ 3d^4 4s^2$
B. $[Ar]\ 3d^4 4s^2$
C. $[Ar]\ 3d^5 4s^0$
[✓ D. $[Ar]\ 3d^5 4s^1$]

Q.4 **Which pair of elements has abnormal electronic configuration**
A. Ti, V
[✓ B. Cr, Cu]
C. Cr, Mn
D. Ni, Co

Q.5 **The general electronic configuration of 3d series of transition elements is**
[✓ A. $[Ar](n-1)d^{1-10}ns^{1-2}$]
B. $[Ar]\ (n-1)d^{1-10}ns^2$
C. $[Ar]\ (n-1)d^{1-2}ns^{1-2}$
D. $[Ar]\ (n-2)d^{1-2}ns^{12}$

Q.6 **Which of the following is a typical transition metal?**
A. Sc
B. Y
C. Cd
[✓ D. Co]

Q.7 **Correct electronic configuration of Mn**
A. $[Ar]\ 3d^3 4s^2$
B. $[Ar]\ 3d^4 4s^2$
C. $[Ar]\ 3d4s^2$
[✓ D. $[Ar]\ 3d^5 4s^2$]

Q.8 **Which of the followings has a complete d-subshell in atomic as well as cationic state**
A. Sc
B. Mn
C. Ti
[✓ D. Zn]

Q.9 **The element which gains electronic configuration of a noble gas at +3 oxidation state**
A. V
B. Ti
[✓ C. Sc]
D. Cr

Q.10 **At which oxidation state Cu achieves electronic configuration of Zn^{+2}**
A. 0
B. +2
[✓ C. +1]
D. +3

Q.11 **Zinc does not show variable oxidation state, because**
A. Its d-subshell is incomplete
[✓ B. Its d-subshell is complete]
C. It is relatively soft metal
D. It has two electrons in outermost shell

Q.12 **Which complex shows zero oxidation state of the transition metal**
[✓ A. $[Fe(CO)_5]$]
B. $K_2[Fe(CN)_6]$
C. $K_3[Fe(CN)_6]$
D. $[Cu(NH_3)_4]SO_4$

Q.13 **The oxidation state of transition elements is usually**
[✓ A. Variable]
B. Single
C. Constant
D. Infinite

Q.14 **The oxidation number of central metal atom in $[Ni(CO)_4]$ is**
[✓ A. 0]
B. 4
C. 2
D. 6

Q.15 **In complex compounds, the oxidation number is written in**
A. English
B. Greek
[✓ C. Roman number]
D. Latin

Q.16 **The oxidation number of Mn in $[MnO_4]^{-2}$ is**
A. +7
B. -7
[✓ C. +6]
D. -6

Q.17 **The highest oxidation state of manganese is**
[✓ A. +7]
B. –7
C. +6
D. +4

Q.18 **Which two pairs show same oxidation state of iron**
A. Fe_2O_3, FeO
B. $FeCl_3$, $FeSO_4$
C. $K_3\left[Fe(CN)_6\right]$,$K_4\left[Fe(CN)_6\right]$
[✓ D. $Fe_2(SO_4)_3$,Fe_2O_3]

Q.19 **Which of the following shows only +2 oxidation state**
A. Sc
[✓ B. Zn]
C. Cu
D. Co

Q.20 **Which electronic configuration can have possibility of +7 oxidation state**
[✓ A. $[Ar]3d^5, 4s^2$]
B. $[Ar]3d^6, 4s^2$
C. $[Ar]3d^5, 4s^1$
D. $[Ar]3d^{10}, 4s^2$

Q.21 **Which has same charge on central metal atom as the co-ordination sphere**
A. $K_4\left[Fe(CN)_6\right]$
B. $\left[Co(NO_2)_3(NH_3)_3\right]$
[✓ C. $\left[Cu(NH_3)_4\right]SO_4$]
D. $[MnCl_4]^{-2}$

Q.22 **Which transition metals serves as catalyst for oxidation of alkanes**
A. Zn
[✓ B. Cu]
C. Hg
D. As

Q.23 **Catalyst used for ammonia synthesis is**
A. Cu
B. Co
C. Zn
[✓ D. Fe]

Q.24 **$TiCl_4$ is used as catalyst for manufacture of**
A. Sulphuric acid
[✓ B. Plastics]
C. Ethanol
D. Tetraethyl lead

Q.25 **Which of the following compound is expected to be colored**
A. Ag_2SO_4
B. $ZnCl_2$
C. MgF_2
[✓ D. CuF_2]

Q.26 **The colour of transition metal complexes is due to:**
[✓ A. d-d transitions of electrons]
B. Paramagnetic nature of transition elements
C. Ionization
D. Loss of s-electrons

Q.27 **Which of the following transition metal forms colourless compounds**
A. Ti
B. Cr
C. Cu
[✓ D. Zn]

Q.28 **Sc^{3+} has $3d^0$ configuration, its colour will be**
[✓ A. Colourless]
B. Purple
C. Blue
D. Green

Q.29 **Number of electrons involved in d-d transition of $\left[Ti(H_2O\ )\right]^{+3}$**
[✓ A. 1]
B. 3
C. 2
D. 4

Q.30 Ti^{+3} shows minimum absorption (maximum transmittance) at _____ wavelength

A. Yellow, Green
B. Red, Yellow
C. Blue, Green
[✓ D. Red, Blue]

Q.31 d-d transition cannot be shows by

A. Cu^{+1}
B. Sc^{+3}
C. Zn^{+2}
[✓ D. All of the above]

Q.32 The algebraic sum of the charges present on the central atom ion and the total charge on the ligands is called

A. Coordination number
B. Coordination sphere
C. Oxidation number
[✓ D. Charge on coordination sphere]

Q.33 While assigning the name of a complex compounds, the correct order is

[✓ A. Cation, Coordination Sphere, Anion]
B. Coordination Sphere, Cation, Anion
C. Cation, Anion, Coordination Sphere
D. Anion, Coordination Sphere, Cation

Q.34 The ability of transition elements to form complexes is due to:

A. Small size of metal ion
B. Highly charged metal ion
[✓ C. Availability of empty d orbitals]
D. All of these

Q.35 When $K_4[Fe(CN)_6]$ is dissolved in a solution of salt, then it produces

A. Simple ions only
B. Complex ions only
[✓ C. Complex ions and simple ions]
D. Weak acid HCN

Q.36 During the formation of complex compound the Ligands bind with central metal ion / atom by

A. Covalent bonds
[✓ B. Co-ordinate covalent bond]
C. Ionic bonds
D. All of these

Q.37 Which one complex is more stable

A. $[Cu(H_2O)_6]^{2+}$
[✓ B. $[Pt(C_2O_4)_2]^{2-}$]
C. $[CuCl_4]^{2-}$
D. All have same stability

Q.38 What is the nature of co-ordination sphere

A. Aninoic in nature
B. Neutral in nature
C. Cationic in nature
[✓ D. All are possible]

Q.39 The geometry of $[Fe(CO)_5]$ is

A. Pyramidal
B. Square planar
C. Octahedral
[✓ D. Bi pyramidal]

Q.40 When light is exposed to transition element, then electrons jump from lower orbitals to higher orbitals in

A. Orbitals of s-subshell
[✓ B. Orbitals of d-subshell]
C. Orbitals of p-subshell
D. Both A. and B.

PAST PAPER QUESTION

Q.1 **The paramagnetic character of substances is due to the presence of** **MDCAT (2010,2011)**

A. Bond pairs of electrons
B. Lone pairs of electron
[✓ C. Unpaired electrons in the atom or molecule]
D. Paired electrons in the valence shell of atoms

Q.2 **Which pair of transition elements shows abnormal electronic configuration?** **MDCAT (2012)**

A. Sc and Zn
B. Zn and Cu
C. Cu and Sc
[✓ D. Cu and Cr]

Q.3 **Electronic configuration of manganese (Mn) is** **MDCAT (2014)**

[✓ A. $\mathrm{Mn(Ar)}\overset{3d}{\boxed{\uparrow}\boxed{\uparrow}\boxed{\uparrow}\boxed{\uparrow}\boxed{\uparrow}}\ \overset{4s}{\boxed{\uparrow\downarrow}}$]
B. $\mathrm{Mn(Ar)}\overset{3d}{\boxed{\uparrow\downarrow}\boxed{\uparrow\downarrow}\boxed{\uparrow}\boxed{\uparrow}\boxed{\uparrow}}\ \overset{4s}{\boxed{\uparrow\downarrow}}$
C. $\mathrm{Mn(Ar)}\overset{3d}{\boxed{\uparrow\downarrow}\boxed{\uparrow\downarrow}\boxed{\uparrow\downarrow}\boxed{\uparrow\downarrow}\boxed{\uparrow\downarrow}}\ \overset{4s}{\boxed{\uparrow}}$
D. $\mathrm{Mn(Ar)}\overset{3d}{\boxed{\uparrow\downarrow}\boxed{\uparrow\downarrow}\boxed{\uparrow\downarrow}\boxed{\uparrow}\boxed{\uparrow}}\ \overset{4s}{\boxed{\uparrow}}$

Q.4 **Electronic configuration of Gold $[Au_{79}]$ is** **MDCAT (2015)**

[✓ A. $[Xe]4f^{14},5d^{10},6s^1$]
B. $[Xe]4f^{14},5d^9,6s^2$
C. $[Xe]4f^{10},5d^{10},6s^2$
D. $[Xe]4f^{14},5d^{10},6s^2$

Q.5 **The anomalous electronic configuration shown by chromium and copper among 3-d series of elements is due to:** **MDCAT (2016)**

A. Colour of ions of these metals
B. Variable oxidation states of metals
[✓ C. Stability associated with this configuration]
D. Complex formation tendency of metals

Q.6 **Which element of 3-d series of periodic table shows the electronic configuration of $3d^8, 4s^2$?** **MDCAT (2016)**

A. Copper
B. Zinc
C. Cobalt
[✓ D. Nickel]

Q.7 **Scandium has atomic number 21; which one will be its electronic configuration?** **MDCAT (2017)**

A. $1s^2, 2s^2, 2p^6, 3s^2, 3s^6, 3d^3$
[✓ B. $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^1$]
C. $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 4p^1$
D. $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1, 4p^2$

Q.8 **Which of the following is the electronic configuration of Cr?** **MDCAT (2019)**

A. $[Ar]3d^5 4s^2$
B. $[Ar]3d^4 4s^2$
C. $[Ar]3d^6 4s^0$
[✓ D. $[Ar]3d^5 4s^1$]

Q.9 **Copper is a typical transition metal. Its atomic number is 29. In which oxidation state does it have partially filled orbital in d-subshell?** **MDCAT (2019)**

A. Cu
[✓ B. Cu^{2+}]
C. Cu^-
D. Cu^+

Q.10 **Valence electronic configuration Cu^{2+} is** ^{29}Cu **NUMS (2019)**

A. $5d^6$
[✓ B. $3d^9$]
C. $3d^8$
D. $3d^7$

Q.11 **The total number of transition element is** NUMS (2019)

[✓ A. 58]
B. 48
C. 30
D. 25

Q.12 **Oxidation state of 'Mn' in $KMnO_4$, K_2MnO_4, MnO_2 and $MnSO_4$ is in the order** MDCAT (2012)

A. +7, +6, +2, +4
[✓ B. +7, +6, +4, +2]
C. +6, +7, +2, +4
D. +4, +6, +7, +2

Q.13 **Which one pair has the same oxidation state of 'Fe'?** MDCAT (2013)

A. $FeSO_4$ and $FeCl_3$
B. $FeCl_2$ and $FeCl_3$
[✓ C. $FeSO_4$ and $FeCl_2$]
D. $Fe_2(SO_4)_3$ and $FeSO_4$

Q.14 **Identify the element that has maximum oxidation states:** MDCAT (2017)

A. Zinc
B. Vanadium
C. Chromium
[✓ D. Manganese]

Q.15 **The geometry of complexes depends upon type of ----------taking place in the valence shell of central metal atom:** MDCAT (2010)

A. Protonation
B. Deprotonation
[✓ C. Hybridization]
D. Dissociation

Q.16 **Tick the correct statement** MDCAT (2011)

[✓ A. Chelates are more stable than ordinary complexes]
B. Ordinary complexes are more stable than chelates
C. Monodentate ligand form chelate
D. Chelates have no ring structure

Q.17 **Oxidation state of 'Fe' in $K_3[Fe(CN)_6]$ is** MDCAT (2013)

A. +2
B. -6
C. -3
[✓ D. +3]

Q.18 **Ligands having two lone pair of electrons for donations to the central transition metal ions are known as** MDCAT (2018)

A. monodentate ligand
B. hexadentate ligand
[✓ C. bidentate ligand]
D. polydentate ligand

Q.19 **The shape of $[Co(NH_3)_6]^{3+}$ complex is** MDCAT (2018)

A. Square planar
B. Tetrahedral
C. Linear
[✓ D. Octahedral]

Q.20 **What are the coordination number of Fe and Cu in the following compounds $K_4[Fe(CN)_6],[Cu(NH_3)]SO_4$ respectively** SET (2019)

A. –6,–4
B. –6, +4(–6,–4)
C. +6,–4
[✓ D. +6, +4]

Q.21 **$\left[Ti(H_2O)_6\right]^{+3}$ transmits** MDCAT (2015)

A. Yellow and red light
B. Red and white light
C. Yellow and blue light
[✓ D. Red and blue light]

Q.22 **Violet color of $\left[Ti(H_2O)_6\right]^{+}$ ion is due to the** MDCAT (2017)

[✓ A. Central metal ion]
B. Water molecule
C. Complex ion
D. Outer anion

Q.23 **The color of transition metal complexes is due to transition of electron between** NUMS (2019)

A. p to d orbitals
[✓ B. d to d orbitals]
C. p to p orbitals
D. d to p orbitals

Q.24 **The octahedral geometry of complexes $\left[Co(NH_3)_6\right]^{3+}$ has hybridization**

NUMS (2019)

A. sp^3d
B. spd^4
[✓ C. sp^3d^2]
D. sp^2d^3

Q.25 **In the complex, potassium hexacyanoferrate (III) $\left[K_3Fe(CN_6)\right]$ the coordination number of Fe is:**

ETEA (2019)

A. 9
C. 3
[✓ B. 6]
D. d

Q.26 **Co-ordination number of $\left[Co(en)_2Cl_2\right]$ is**

ETEA (2019)

A. -2
[✓ B. 6]
C. 4
D. None of the above

Q.27 **In 3rd series of transition elements, paramagnetic behavior is maximum for Mn^{+2} and**

NMDCAT (2020)

[✓ A. Cr^{3+}]
B. Ti^{3+}
C. V^{3+}
D. Zn^{2+}

Q.28 **Electronic configuration of chromium (proton number 24) is:**

NMDCAT (2020)

A. [Ar] $3d^4 4s^2$
B. [Ar] $3d^5 4s^2$
[✓ C. [Ar] $3d^5 4s^1$]
D. [Ar] $3d^5 4s^2$

Q.29 **The transition element which doesn't show variable valency is**

NMDCAT (2020)

A. Cu
B. Sc
[✓ C. Zn]
D. Cr

ANSWER KEY »

1	A	11	B	21	C	31	D
2	B	12	A	22	B	32	D
3	D	13	A	23	D	33	A
4	B	14	A	24	B	34	C
5	A	15	C	25	D	35	C
6	D	16	C	26	A	36	B
7	D	17	A	27	D	37	B
8	D	18	D	28	A	38	D
9	C	19	B	29	A	39	D
10	C	20	A	30	D	40	B

PAST PAPER QUESTIONS

1	C	6	D	11	A	16	A	21	D	26	B
2	D	7	B	12	B	17	D	22	A	27	A
3	A	8	D	13	C	18	C	23	B	28	C
4	A	9	B	14	D	19	D	24	C	29	C
5	C	10	B	15	C	20	D	25	C		

EXPLANATORY NOTES

$_{25}Mn^{+2}$ $\quad {}_{18}[Ar]\ \underset{4s}{\boxed{}}\ \underset{3d}{\boxed{\upharpoonleft}\boxed{\upharpoonleft}\boxed{\upharpoonleft}\boxed{\upharpoonleft}\boxed{\upharpoonleft}}$

Q.1 A.

$_{29}Cu^{+2}$ $\quad {}_{18}[Ar]\ \underset{4s}{\boxed{}}\ \underset{3d}{\boxed{\upharpoonleft}\boxed{\upharpoonleft\downharpoonright}\boxed{\upharpoonleft\downharpoonright}\boxed{\upharpoonleft\downharpoonright}\boxed{\upharpoonleft\downharpoonright}}$

C.

$_{26}Fe^{+3}$ $\quad {}_{18}[Ar]\ \underset{4s}{\boxed{}}\ \underset{3d}{\boxed{\upharpoonleft}\boxed{\upharpoonleft}\boxed{\upharpoonleft}\boxed{\upharpoonleft}\boxed{\upharpoonleft}}$

B.

Q.2 Transition element are those elements which lie between s and p – block elements and their properties are also between s and p – block elements.

Q.3 In 3d series (1st series of transition elements), two elements "Cr" and "Cu" have different electronic configuration.

$_{24}Cr \quad [Ar]\ 3d^{5}\ 4s^{1}$

$_{29}Cu \quad [Ar]\ 3d^{10}\ 4s^{1}$

Q.4 Two elements "Cr" and "Cu" have different electronic configuration.

$_{24}Cr \quad [Ar]\ 3d^{5}\ 4s^{1}$

$_{29}Cu \quad [Ar]\ 3d^{10}\ 4s^{1}$

Q.5 d – block (outer) transition elements are those in which d – subshell of penultimate shell (inner to valence shell) is in process of completion. So general electronic configuration of 3d series is $(n-1)\,d^{1-10}\,ns^{1-2}$.

Q.6 Typical transition elements show general properties (colour, paramagnetism, alloy formation etc.) of transition elements while non-typical transition element don't show general properties of transition elements. Group No. IIIB (Sc, Y, La and IIB (Zn, Cd, Hg) are non-typical transition elements while group No. (IVB, VB, VIB, VIIB, VIIIB and IB) are typical transition elements.

Q.7 Electronic configuration of Mn is $_{25}Mn \quad {}_{18}[Ar]\ 4s^{2}\ 3d^{5}$.

Q.8

(A) $_{21}Sc \quad {}_{18}[Ar]\ 4s^{2}\ 3d^{1}$

$Sc^{+3} \quad {}_{18}[Ar]\ 4s^{0}\ 3d^{0}$

(B) $_{21}Ti \quad {}_{18}[Ar]\ 4s^{2}\ 3d^{2}$

$Ti^{+3} \quad {}_{18}[Ar]\ 4s^{0}\ 3d^{1}$

(C) $_{25}Mn \quad {}_{18}[Ar]\ 4s^{2}\ 3d^{5}$

$Mn^{+2} \quad {}_{18}[Ar]\ 4s^{0}\ 3d^{5}$

(D) $_{30}Zn \quad {}_{18}[Ar]\ 4s^{2}\ 3d^{10}$

Zn^{+2} $_{18}[Ar]\ 4s^{0}\ 3d^{10}$

Q.9

$_{21}Sc$ $_{18}[Ar]\ 4s^{2}\ 3d^{1}$

$_{21}Sc^{+3}$ $_{18}[Ar]\ 4s^{0}\ 3d^{0}$

Scandium in +3 state has same electronic configuration as $_{18}Ar$.

$_{18}Ar$ $1s^{2}2s^{2}2p^{6}3s^{2}3p^{6}$

Q.10

Cu^{+1} $_{18}[Ar]\ 4s^{0}\ 3d^{10}$

Zn^{+2} $_{18}[Ar]\ 4s^{0}\ 3d^{10}$

Q.11

$_{30}Zn$ $_{18}[Ar]\ 4s^{2}\ 3d^{10}$

Zn^{+2} $_{18}[Ar]\ 4s^{0}\ 3d^{10}$

Q.12

$\left[\overset{0}{Fe}(CO)_5\right]$, $K_2\left[\overset{+4}{Fe}(CN)_6\right]$

C. $K_3\left[\overset{+3}{Fe}(CN)_6\right]$, $\left[\overset{+2}{Cu}(NH_3)_4\right]SO_4$

Q.13 Transition elements show variable state because in addition to 4s – electrons, 3d –electrons also take part in bonding.

Q.14 $\left[\overset{0}{Ni}(\overset{0}{CO})_4\right]^{0}$

Oxidation state on CO = 0

Overall coordination sphere has zero charge. So Ni has zero oxidation state.

Q.15 Oxidation number of central metal in the complex is written in roman number i.e.

$K_3\left[\overset{+3}{Fe}(CN)_6\right]$ Potassium Hexacyanoferrate (III) .

Q.16 Oxidation no of Mn = ?

Oxidation no of O = –2

Overall charge on coordination sphere = –2

Mn + 4(–2) = –2

Mn – 8 = –2

Mn = 8 –2

Mn = +6

Q.17 Mn belongs to group (VIIB)of periodic table. So, its maximum oxidation state should be +7. Because maximum oxidation state may be equal to group no of element.

Q.18

Oxidation state of Fe in $Fe_2(SO_4)_3$	Oxidation state of Fe in Fe_2O_3
Charge on sulphate ion = –2 $2Fe + 3(-2) = 0$ $2Fe - 6 = 0$ $2Fe = +6$ $Fe = +3$	Charge on oxygen = –2 $2Fe + 3(-2) = 0$ $2Fe - 6 = 0$ $2Fe = +6$ $Fe = +3$

Q.19 "Zn" is non-typical transition element it does not show variable oxidation state. So it shows only +2 oxidation state.
i.e $Zn^{2+} = [Ar]4s^0\,3d^{10}$

Q.20 $[Ar]\,2\overset{5}{d}\;4\overset{2}{s}$ is electronic configuration of Mn. It shows maximum +7 oxidation state because it belongs to group VIIB of periodic table.

Q.21 In B option CMA and coordination sphere has same charge

A. $\overset{+4}{K_4}\left[\overset{+2}{Fe}\overset{-6}{(CN)_6}\right]^{-4}$

C. $\left[\overset{+2}{Cu}\overset{0}{(NH_3)_4}\right]^{+2} SO_4^{-2}$

B. $\left[\overset{+3}{Co}\overset{-3}{(NO_2)_3}\overset{0}{(NH)_3}\right]^{0}$

D. $\left[\overset{+2}{Mn}\overset{-4}{Cl_4}\right]^{-2}$

Q.22 "Cu" is used as catalyst in oxidation of lower alkanes.

$$CH_4 + [O] \xrightarrow[200\ \text{atom}]{Cu/400°C} CH_3 - OH.$$

Q.23 Finely divided "Fe" is used as a catalyst in Haber process. $Cr_2O_3 + MgO + SiO_2$ is used as promoter.

$$N_2 + 3H_2 \xrightleftharpoons[450°C/200\ \text{atom}]{Fe/MgO/Cr_2O_3/SiO_2} 2NH_3$$

Q.24 For high quality polyethylene (plastiB., $(C_2H_5)_3Al + TiCl_4$ is used as catalyst.

$$n(CH_2 = CH_2) \xrightarrow[\text{traces of } O_2(0.1\%)400°C/100\ \text{atom}]{(C_2H_5)_3Al+TiCl_4} [CH_2 - CH_2]_n$$

Q.25

Copper in +2 state contain one unpaired electron so it shows d-d transition and certain colour.

$$Cu^{+2} \quad {}_{18}[Ar]\underset{4s}{\boxed{}}\;\underset{3d}{\boxed{\uparrow}\boxed{\uparrow\downarrow}\boxed{\uparrow\downarrow}\boxed{\uparrow\downarrow}\boxed{\uparrow\downarrow}}$$

Q.26 Following ions of 3d-series contain no unpaired electrons. So, these don't show d-d transition and certain colour
Sc^{+3}, Ti^{+4}, V^{+5}, Cu^{+1} and Zn^{+2}

Q.27 Zinc has complete d-subshell. There is no d-d transition, therefore zinc form a colorless complex

Q.28 $_{21}Sc \quad _{18}[Ar]\ 4s^2\ 3d^1$

$Sc^{+3} \quad _{18}[Ar]\ 4s^0\ 3d^0$

Q.29

$$\left[\overset{+3}{Ti}(H_2\overset{0}{O})_6\right]^{+3}$$

$_{22}Ti \quad [Ar]\ 4s^2\ 3d^2$

$_{22}\overset{+3}{Ti} \quad _{18}[Ar]\ 4s^0\ 3d^1$

Q.30 In $[Ti(H_2O)_6]^{+3}$, yellow light is absorbed while most of the red and blue lights are transmitted, therefore the solution of $[Ti(H_2O)_6]^{+3}$ ions looks violet in colour.

Q.31 Following ions of 3d-series contain no unpaired electrons. So, these don't show d-d transition and certain colour

Sc^{+3}, Ti^{+4}, Cu^{+1} and Zn^{+2}

Q.32 $\left[Fe(CN)_6\right]^{-4}$ The algebraic sum of central metal and ligand is -4. It is charge on sphere

Q.34 Transition metals can form complexes because these have vacant d–orbital in which ligands can donate electron pairs.

Q.35 $K_4\left[Fe(CN)_6\right] \xrightarrow{\text{Ionization}} 4K^+ + \left[Fe(CN)_6\right]^{-4}$

Q.36 In coordination compounds, ligands are Lewis bases and central metal atom are Lewis acid so these form coordinate covalent bond.

Q.37 Complexes formed by poly-dentate ligands are called chelates. Oxalate ion $\left(C_2O_4^{-2}\right)$ is poly-dentate ligand so it will form chelates. These are stable compounds due to ring structure.

Q.38 A. Anionic coordination sphere $K_4[Fe(CN)_6]$

B. Neutral coordination sphere $[Fe(CO)_5]$

C. Cationic coordination sphere $[Cu(NH_3)_4]SO_4$

Q.39 There are five carbonyl (CO) ligands attached with central atom (Fe), so coordination no is 5. If coordination no. is 5 then geometry is Trigonal bipyramidal.

Q.40 When d-orbitals are involved in bonding, they split into two energy levels (lower and higher). Electrons present in low energy level absorb a part of visible light and jump to higher energy level. This is called d-d transition. Due to this transition, metal ion show colour.

Topic-12

EXPLANATORY NOTES

(PAST PAPER QUESTIONS)

Q.1 The paramagnetic behaviour of substance is due to presence of unpaired electrons in it.

Q.2 $_{24}Cr$ and $_{29}Cu$ is the pair of 3d series which shows abnormal behaviour in electronic configuration due to the stability of d-subshell.

Q.3 Electronic configuration of manganese $_{25}Mn$ is given below

$$Mn=[Ar]\overset{3d}{\boxed{\uparrow}\boxed{\uparrow}\boxed{\uparrow}\boxed{\uparrow}\boxed{\uparrow}}\ \overset{4s}{\boxed{\uparrow\downarrow}} \text{ or } Mn = 1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^5$$

Q.4 Electronic configuration of Gold $[Au_{79}]$ is $[Xe]4f^{14}, 5d^{10}, 6s^1$

Q.5 The anomalous electronic configuration is due to stability associated to their electronic configuration or stability of d-subshell because haf filled or completely filled subshell is more stable.

Q.6 The given configuration is for Ni_{28}. $Ni = [Ar]4s^2, 3d^8$

Q.7 $Sc_{21} = 1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^1$

Q.8 $Cr_{24} = [Ar]4s^1, 3d^5$

Q.9 $Cu_{29} = [Ar]4s^1, 3d^{10}$ and $Cu^{+2}_{29} = [Ar]4s^1, 3d^9$ or $Cu^{+2}_{29} = [Ar]\overset{3d}{\boxed{\uparrow\downarrow}\boxed{\uparrow\downarrow}\boxed{\uparrow\downarrow}\boxed{\uparrow\downarrow}\boxed{\uparrow}}\ \overset{4s}{\boxed{}}$

Q.10 Valence electronic configuration Cu^{2+} is $Cu^{+2}_{29} = [Ar]4s^1, 3d^9$

Q.11 There are 58 total transition elements, 40 outer transition elements (d-block) and 28 inner transition elements (f-block).

Q.12 Oxidation state of 'Mn' in $KMnO_4$, K_2MnO_4, MnO_2 and $MnSO_4$ is in the order is +7, +6, +4, +2 as given below

$KMnO_4$	K_2MnO_4	MnO_2	$MnSO_4$
$K + Mn + 4(O) = 0$	$2K + Mn + 4(O) = 0$	$Mn + 2(O) = 0$	$Mn + (SO_4^{-2}) = 0$
$(1) + Mn + (-8) = 0$	$(2) + Mn + (-8) = 0$	$Mn + (-4) = 0$	$Mn + (-2) = 0$
$Mn + (-7) = 0$	$Mn + (-6) = 0$	$Mn = 4$	$Mn = 2$
$Mn = 7$	$Mn = 6$	$Mn = 4$	$Mn = 2$

Q.13 $FeSO_4$ and $FeCl_2$ this pair has same oxidation state which is +2.

$FeCl_2$	$FeSO_4$
$Fe + 2(Cl) = 0$	$Fe + (SO_4^{-2}) = 0$
$Fe + 2(-1) = 0$	$Fe + (-2) = 0$
$Fe + (-2) = 0$	$Fe = 2$
$Fe = 2$	$Fe = 2$

Q.14 Mn has maximum oxidation state (+7), $Mn_{25} = [Ar]4s^2, 3d^5$

Q.15 Geometry of complexes depends upon hybridization i.e. sp^3 has tetrahedral and dsp^2 has square planer geometry.

Q.16 Chelates are more stable than ordinary complexes due to formation of 5 or 6 members cyclic structure.

Q.17 Oxidation state of Fe in $K_3[Fe(CN)_6]$ is +3, as

$$3(K) + Fe + 6(CN^{-1}) = 0$$
$$3(+1) + Fe + 6(-1) = 0$$
$$Fe + 3 + (-6) = 0$$
$$Fe + (-3) = 0$$
$$Fe = 3$$

Q.18 Ligands having two lone pair of electrons for donations to the central transition metal ions are known as bidentate ligands e.g. hydrazine and ethylenediammine.

Q.19 The shape of $[Co(NH_3)_6]^{3+}$ complex is octahedral.

Q.20 $[Fe(CN)_6],[Cu(NH_3)_4]SO_4$ in the given compounds, Fe has 6 ligands while Cu has 4 ligands so their coordination number are 6 and 4 respectively.

Q.21 $[Ti(H_2O)_6]^{+3}$ transmits red and blue light during d-d transition.

Q.22 Colours of complex compounds are due d-d transition of central metal atom or ion.

Q.23 The color of transition metal complexes is due to transition of electron between d-d orbitals.

Q.24 Octahedral geometry of given complex is due sp^3d^2 because ammonia ligand use vacant orbitals of 4d, as 3d has no vacant orbital to accommodate the ligands.

Q.25 $[K_3Fe(CN_6)]$ In this complex Fe metal ion is surrounded by 6 ligands, so its coordination number is six.

Q.26 Co-ordination number of $[Co(en)_2Cl_2]$ is six, as ethylenediammine (en) is bidentate ligand so total six electron pairs are donated to Co-metal ion.

Q.27 In the given ions Cr^{+3} and Mn^{+2} has maximum unpaired electrons so have maximum paramagnetic behaviour.

Q.28 Electronic configuration of chromium (proton number 24) is $[Ar]4s^1, 3d^5$

Q.29 Zinc (Zn) does not show variable oxidation state because of unavailability of unpaired electrons in d-subshell.

Topic 13

FUNDAMENTAL CONCEPTS OF ORGANIC CHEMISTRY

PRACTICE EXERCISE

Q.1 _______ **organic compound/s can be classified as acyclic**
A. Isobutane
B. Isobutylene
C. Isopentyne
[✓ D. All of these]

Q.2 **Compounds containing ring of three or more than three carbon atom and resembling _______ compounds are called alicyclic**
[✓ A. Aliphatic]
B. Aromatic
C. Benzene
D. Heterocyclic

Q.3 **Alicyclic hydrocarbons will not follow _____ general formula**
A. C_nH_{2n}
B. C_nH_{2n-2}
[✓ C. C_nH_{2n+2}]
D. C_nH_{2n-4}

Q.4 **Cyclohexane can be classified as**
A. Carbocyclic
B. Aromatic
C. Alicyclic
[✓ D. Both A and C]

Q.5 **How many secondary carbon atoms are present in Methylcylopropane**
A. 1
B. 3
[✓ C. 2]
D. 0

Q.6 **Which of the following is not heterocyclic compound**
[✓ A. Naphthalene]
B. Furan
C. Pyridine
D. Pyrrole

Q.7 **The aliphatic compounds are of two types**
A. Straight chain and cyclic
B. Branched chain and alicyclic
[✓ C. Straight chain and branched]
D. Homocyclic and alicyclic

Q.8 **Which is not present as heteroatom in heterocyclic compounds**
A. Sulphur
B. Nitrogen
C. Oxygen
[✓ D. Chlorine]

Q.9 **Which compounds is alicyclic in nature**
[✓ A. Cyclobutane]
B. Iso-butane
C. n-Butane
D. Toluene

Q.10 **1st synthetic organic compound is**
A. Ammonium cyanate
[✓ B. Urea]
C. Methane
D. Benzene

Q.11 **Pyridine is an example of**
A. Homocyclic compound
[✓ B. Heterocyclic compound]
C. Carbocyclic compound
D. Aliphatic compound

Q.12 **Anthracene contains _______ number of fused benzene rings**
A. 1
B. 2
[✓ C. 3]
D. 4

Q.13 **The isomerism in which the compounds differ with respect to functional group but have same molecular formula is called:**
A. Metamerism
[✓ B. Functional group isomerism]
C. Position isomerism
D. Chain isomerism

Q.14 **Ether shows the phenomenon of:**
A. Position isomerism
B. Functional group isomerism
[✓ C. Metamerism]
D. Cis trans isomerism

Q.15 Which of the following compounds does not exhibit positional isomerism

A. Alkynes
B. Nitroalkanes
[✓ C. Carboxylic acid]
D. Alcohol

Q.16 Total number of possible chain isomers of butylalcohol among alcohols are

[✓ A. Four]
B. Five
C. Three
D. Six

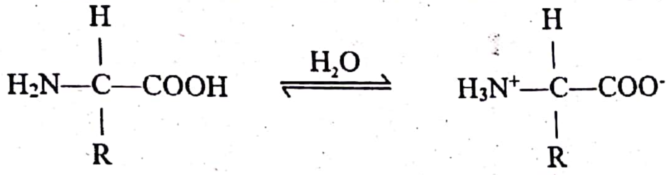
Q.17 Alkanes do not show geometrical isomerism due to

A. Asymmetry
B. Resonance
[✓ C. Rotation around single bond]
D. Restricted rotation around doubled bond

Q.18 How many esters are possible for $C_4H_8O_2$

A. 2
B. 3
[✓ C. 4]
D. 5

Q.19 The type of isomerism shown in the following species is



$$H_2N{-}\underset{R}{\overset{H}{C}}{-}COOH \xrightleftharpoons{H_2O} H_3N^+{-}\underset{R}{\overset{H}{C}}{-}COO^-$$

A. Functional group isomerism
[✓ B. Tautomerism]
C. Metamerism
D. Cis-trans isomerism

Q.20 Which class of compound cannot show positional isomerism

[✓ A. Alkanes]
B. Alkene
C. Alkynes
D. Alcohol

Q.21 Which one is thioether

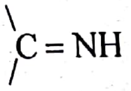
A. R – O – R
B. R – Se – R
[✓ C. R – S – R]
D. R – Te – R

Q.22 Glycols and glycerols can be differentiated on the basis of

A. Number of carbon atom
B. Number of hydroxyl group
C. Position of hydroxyl group
[✓ D. All of these]

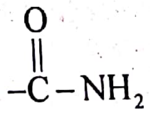
Q.23 Which of the following is functional group of amino functional group

[✓ A. $-NH_2$]

B. 

$>C=NH$

C. $-C\equiv N$

D. 

$-\overset{\overset{O}{\|}}{C}-NH_2$

Q.24 Select from the following the one which is alcohol

[✓ A. $CH_3{-}CH_2{-}OH$]
B. CH_3COOH
C. $CH_3{-}O{-}CH_3$
D. $CH_3{-}CH_2{-}Br$

Q.25 Which one of the following class of compounds has been incorrectly matched with their general formulae

A. Phenol ...... Ar –OH
B. Ketone .... R – COR
C. Carboxylic acid .... RCOOH
[✓ D. Aldehyde .... ROR]

Q.26 Which of the following is an amide

[✓ A. $(NH_2)_2CO$]
B. NH_2CH_3
C. $C_6H_5NH_2$
D. $N(CH_3)_3$

Q.27 sp-hybridization takes place by the mixing of orbitals
A. One 1s, one 2p
B. One 2s, three 2p
C. One 2s, two 2p
[✓ D. One 2s, one 2p]

Q.28 The percentage of s character in sp^2 hybrid orbital is
A. 25%
[✓ B. 33.3%]
C. 50%
D. 75%

Q.29 The percentage of p character in sp^3 hybrid orbital is
A. 25%
[✓ B. 75%]
C. 50%
D. 33%

Q.30 In sp^2-hybridization, the angle between two hybrid orbitals is
[✓ A. 120°]
B. 180°
C. 109.5°
D. 90°

Q.31 In t-butyl alcohol, tertiary carbon is bonded to:
A. Two hydrogen atoms
B. Three hydrogen atoms
C. One hydrogen atom
[✓ D. No hydrogen atom]

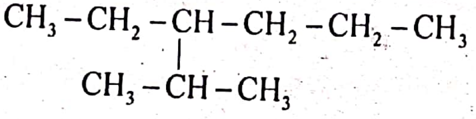
Q.32 IUPAC name of neopentane
A. 2,2- Dimethyl pentane
B. 2,3- Dimethyl pentane
[✓ C. 2,2- Dimethyl propane]
D. 2,2- Dimethyl butane

Q.33 Propene and propyne have general formula
[✓ A. C_nH_{2n} and C_nH_{2n-2}]
B. C_nH_{2n-2} and C_nH_{2n+2}
C. C_nH_{2n+2}
D. C_nH_{2n} and C_nH_{2n+2}

Q.34 Choose the correct name according to IUPAC nomenclature
A. 2–Ethyl–3–methyl pentane
[✓ B. 3–Ethyl–2–methyl pentane]
C. 3-Methyl cyclohexane
D. 3–Ethyl–4–methyl pentane

Q.35 Indicate the number of chain isomers that can be obtained from the C_6H_{14}?
A. 7
B. 6
[✓ C. 5]
D. 4

Q.36 What is the IUPAC name of this structure



$$CH_3-CH_2-\underset{\displaystyle CH_3-CH-CH_3}{\underset{|}{CH}}-CH_2-CH_2-CH_3$$

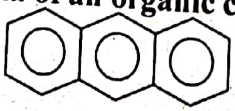
A. 3–Ethyl 2–methyl hexane
B. Iso propyl hexane
C. 4–Ethyl 5–methyl hexane
[✓ D. 3–Iso propyl hexane]

Q.37 The correct name of 3,5,5-Trimethylhexane is
A. 3–Ethyl 2–methyl pentane
B. 2,3–Dimethylpentane
[✓ C. 2,2,4-Trimethylhexane]
D. 2,3,4-Trimethylhexane

Q.38 Which suffix is used for carboxylic acid
A. – al
[✓ B. – oic]
C. – ol
D. – ene

Q.39 The IUPAC name of given compound is $CH_3CH(CH_3)CH_2Cl$
A. 1–Chloro-2–methylbutane
B. Iso-butyl chloride
[✓ C. 1–Chloro-2–methylpropane]
D. 2-Chloro-2-methyl propane

Q.40 Skeletal formula of an organic compound is given below



Name of this compound is
A. Naphthalene
B. Pyrene
[✓ C. Anthracene]
D. Biphenyl methane

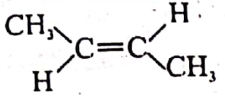
PAST PAPER QUESTIONS

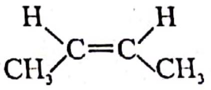
Q.1 **1-chloroproane and 2-chloropropane are isomers of each other. The type of isomerism** MDCAT (2011)

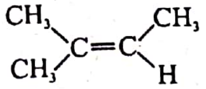
A. Cis-trans isomerism B. Chain isomerism

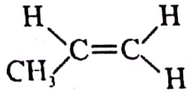
[✓ C.] Positional isomerism D. Functional group isomerism

Q.2 **The cis-isomerism is shown by** MDCAT (2013)

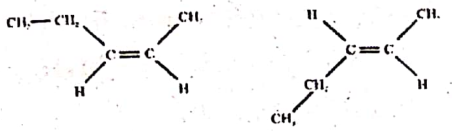
A.


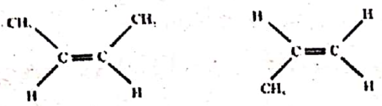
[✓ B.]


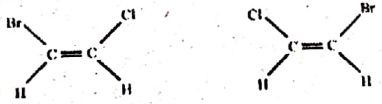
C.


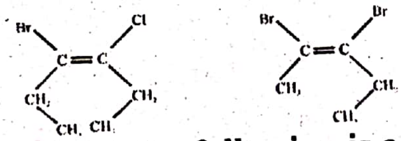
D.


Q.3 **Which one of the following pair of compound is cis and trans isomers of each other?** MDCAT (2014)

[✓ A)]


B)


C)


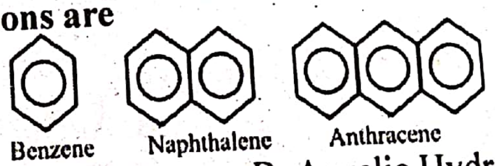
D)


Q.4 **Which one of the following is a ketone?** MDCAT (2014)

A. $CH_3—O—CH_2—CH_3$ B. $CH_3COCOOH$

[✓ C.] $CH_3—CO—CH_2—CH_3$ D. $CH_3—CH_2CHO$

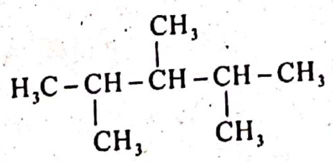
Q.5 **The given three hydrocarbons are** MDCAT (2015)

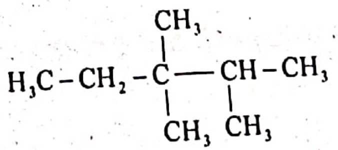


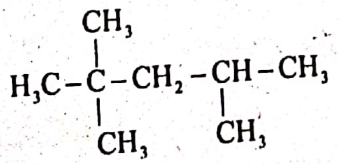
A. Alicyclic hydrocarbons B. Acyclic Hydrocarbons

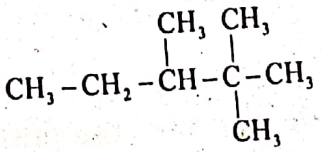
[✓ C.] Aromatic hydrocarbons D. Heterocyclic hydrocarbons

Q.6 **The structural formula of 2,3,4 trimethylpentane is** MDCAT (2015)

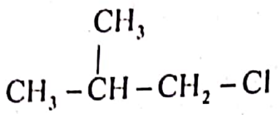
[✓ A.]

$H_3C-\underset{CH_3}{CH}-\overset{CH_3}{CH}-\underset{CH_3}{CH}-CH_3$

B.

$H_3C-CH_2-\overset{CH_3}{\underset{CH_3}{C}}-\underset{CH_3}{CH}-CH_3$

C.

$H_3C-\overset{CH_3}{\underset{CH_3}{C}}-CH_2-\underset{CH_3}{CH}-CH_3$

D.

$CH_3-CH_2-\overset{CH_3}{CH}-\overset{CH_3}{\underset{CH_3}{C}}-CH_3$

Q.7 **The IUPAC name of the given compound is** **MDCAT (2015)**



$CH_3-\overset{\overset{CH_3}{|}}{C}H-CH_2-Cl$

●. 1–Chloro-2-methylpropane B. Isobutyl chloride

C. 1-Chloro-2-methylbutane D. 2-Methyl-3-chloropropane

Q.8 **Which one of the following pairs can be a cis-trans isomer to each other?MDCAT (2016)**

A. $CHCl = CCl_2$ and $CH_2 = CH_2$

● $CHCl = CH_2$ and $CH_2 = CHCl$

B. CH_3-$CH=CH$-CH_3 and H_3C-$CH=CH$-CH_3

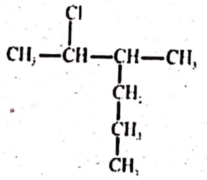
D. CH_3-CH_3 and $CH_2 = CH_2$

Q.9 **The type of structural isomerism which arises due to the difference in the nature of carbon chain or carbon skeleton is** **MDCAT (2017)**

●. Chain isomerism B. Cis-Trans isomerism

C. Position isomerism D. Optical isomerism

Q.10 **Which one of the followings is the best name according to IUPAC system for the formula given below?** **MDCAT (2017)**



A. 4-methyl-6-chloro heptane

●. 2-chloro-3-methyl hexane

C. 2-chloro-4n propyl hexane

D. 2-chloro-4-n propyl pentane

Q.11 **Cyclobutane structure is categorized under:** **MDCAT (2017)**

A. Aromatic compounds B. Aliphatic compounds

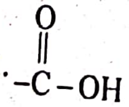
●. Alicyclic compounds D. Heterocyclic compounds

Q.12 **Name the compound, which shows geometric isomerism:** **MDCAT (2017)**

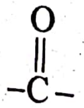
A. 1-bromo-2-chloropropene B. 2,3-dimethylpropene

C. 2-pentene ●. Both A & C

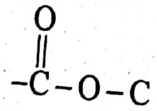
Q.13 **Which one is a functional group of carboxylic acid:** **MDCAT (2017)**

●. 

$-\overset{\overset{O}{\|}}{C}-OH$

B. 

$-\overset{\overset{O}{\|}}{C}-$

C. 

$-\overset{\overset{O}{\|}}{C}-O-C$

D. None of these

Q.14 **Butane molecule can have maximum no of isomers** **MDCAT (2018)**

●. 2 B. 5

C. 4 D. 3

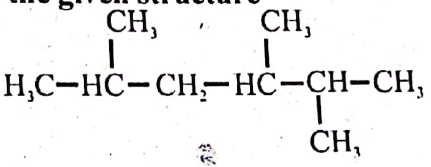
Q.15 Select one which is alcohol MDCAT (2018)

A. CH_3-O-CH_3
[✓ B.] CH_3-CH_2-OH
C. CH_3COOH
D. CH_3-CH_2-Br

Q.16 In the following organic compound carbon atoms in all of them undergo both sp^3 and sp^2 hybridization except X, which has all sp^3 hybrid orbitals, identify X MDCAT (2018)

[✓ A.] 1-butanol
B. Trans to butene
C. 2-chloro - 2- butene
D. Butanoic acid

Q.17 Have a critical look at the given structure



$H_3C-\overset{CH_3}{\overset{|}{HC}}-CH_2-\overset{CH_3}{\overset{|}{HC}}-\underset{CH_3}{\underset{|}{CH}}-CH_3$

The IUPAC name of this compound is SET (2019)

A. 2-Methyl-4-isopropylpentane
[✓ B.] 2,3,5-Trimethylhexane
C. 2,4,5-Trimethylhexane
D. 2-Isobutyl-3-methylbutane

Q.18 IUPAC name of Divinyl acetylene is NUMS (2019 RC)

A. 1,5- hexadiene-3-ene
B. 1,5- hexadiene-3-yne
[✓ C.] 3-Hexane-1,5-diyne
D. 3-Hexyne-1,5-diene

Q.19 Diethyl ether and n-butanol are NUMS (2019 RC)

A. Position isomerism
B. Functional isomerism
[✓ C.] Chain isomerism
D. Tautomerism

Q.20 The number of isomers of pentane is ETEA (2019)

A. 2
B. 4
C. 5
[✓ D.] 3

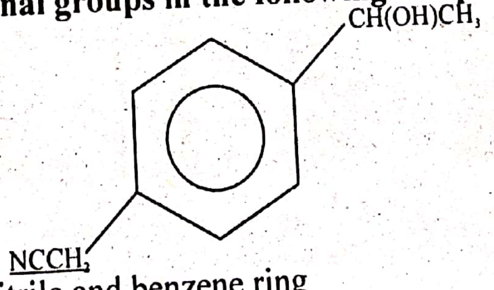
Q.21 Which of the following is not the major source of organic compound? ETEA (2019)

A. Natural gas
B. Petroleum
C. Coal
[✓ D.] Ammoniacal liqour

Q.22 $C_4H_{11}N$ gives the type of isomerism ETEA (2019)

[✓ A.] Metamerism
B. Optical isomerism
C. Tautomerism
D. None of the above

Q.23 The names of functional groups in the following compound X are; MDCAT (2019)



A. Primary alcohol, nitrile and benzene ring
[✓ B.] Secondary alcohol, nitrile and aryl ring
C. Secondary alcohol, nitrile and phenol ring
D. Secondary alcohol, amine and benzene ring

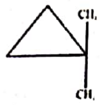
Q.24 Select the organic compound which belongs to arene family: NMDCAT (2020)

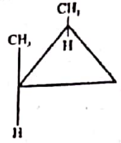
A. $CH_2=CH_2$
B. CH_3-O-CH_3
C. CH_3-NH_2
[✓ D.] C_6H_6

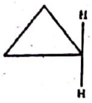
Q.25 **The type of isomerism existing in a compound of molecular formula C_2H_6O is:** **NMDCAT (2020)**

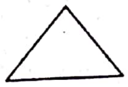
A. Functional group
B. Position
C. Chain
D. Metamerism

Q.26 **Which of the following compound show geometric isomerism?** **NMDCAT (2020)**

A.


B.


C.


D.


Q.27 **Generic formula of cycloalkane is** **NMDCAT (2020)**

A. C_nH_{2n+2}
B. C_nH_{2n}
C. C_nH_{2n-1}
D. C_nH_{2n-2}

Q.28 **In alkanes, each carbon has hybridization** **NMDCAT (2020)**

A. sp^3
B. sp
C. sp^2
D. dsp

ANSWER KEY

1	D	11	B	21	C	31	D
2	A	12	C	22	D	32	C
3	C	13	B	23	A	33	A
4	D	14	C	24	A	34	B
5	C	15	C	25	D	35	C
6	A	16	A	26	A	36	D
7	C	17	C	27	D	37	C
8	D	18	C	28	B	38	B
9	A	19	B	29	B	39	C
10	B	20	A	30	A	40	C

PAST PAPER QUESTIONS

1	C	6	A	11	C	16	A	21	D	26	B
2	B	7	A	12	D	17	B	22	A	27	B
3	A	8	C	13	A	18	C	23	B	28	A
4	C	9	A	14	A	19	C	24	D		
5	C	10	B	15	B	20	D	25	A		

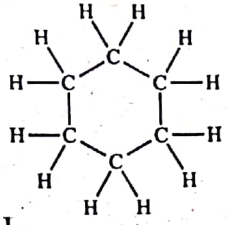
EXPLANATORY NOTES

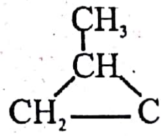
Q.1 Isobutane, isopentane and isobutylene are open chain acyclic compounds

Q.2 Carbon can form open chain (aliphatic and closed chain (alicyclic) compounds showing no aromatic character.

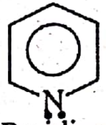
Q.3 C_nH_{2n+2} is valid only in case of saturated open chain hydrocarbons

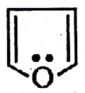
Q.4 The formula of cyclohexane is following

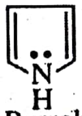


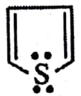
Q.5 In methyl cyclopropane  there is one primary carbon, one tertiary carbon and two secondary carbon atoms

Q.6 The compounds which contain at least one atom other than carbon in the ring are heterocyclic compounds. The following are heterocyclic compound


Pyridine


Furan


Pyrrole


Thiophene

Q.7 Aliphatic or open chain compounds are further classified as straight chain and branched compounds

Q.8 In heterocyclic compounds only that heteroatom is possible which has valency of two or more. Therefore chlorine cannot be a heteroatom because it forms only one bond in order to complete its octet.

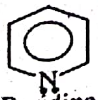
Q.9 A. Alicyclic, B. Branched hydrocarbon, C. Straight chain hydrocarbon and D. Aromatic compound

Q.10 Urea is first synthetic organic compound

$$NH_4CNO \rightleftharpoons NH_2CONH_2$$

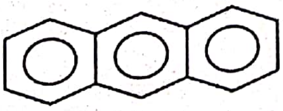
Ammonium cyanate Urea

Q.11


Pyridine

Pyridine is an example of heterocyclic compound.

Q.12


(Anthracene)

Q.13

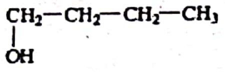
Functional group isomerism	Same molecular formula, but different functional groups	Different	propanal and propanone

Q.14

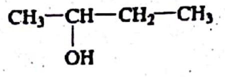
Metamerism	Unequal distribution of carbon atoms (R) on either side of functional group	Same	diethyl ether and methyl n-propyl ether

Q.15 In carboxylic acids position of functional group does not change therefore they do not show positional isomerism

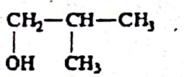
Q.16


$CH_2-CH_2-CH_2-CH_3$ (OH on C_1)

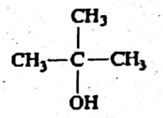
n-butyl alcohol
1-butanol
b.p. 118 °C


$CH_3-CH(OH)-CH_2-CH_3$

sec-butyl alcohol
2-butanol
b.p. 99 °C


$CH_2(OH)-CH(CH_3)-CH_3$

isobutyl alcohol
2-methyl-1-propanol
b.p. 108 °C

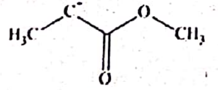

$CH_3-C(CH_3)(OH)-CH_3$

t-butyl alcohol
2-methyl-2-propanol
b.p. 82 °C

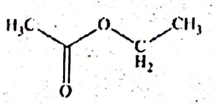
Q.17 Alkanes do not show geometrical isomerism due to free rotation around single bond

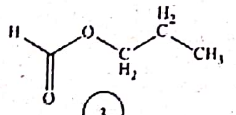
Q.18

①

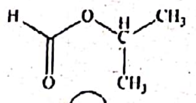


②





③



④

Q.19 The shifting of proton within the molecule is called tautomerism

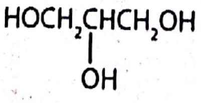
Q.20 In alkanes there is no functional group, therefore it can not show positional isomerism

Q.21 Thioether is similar to ether, but in place of O-atom, it has S-atom

Q.22 Structure of ethylene glycol and glycerol are given below

$HOCH_2CH_2OH$

Ethylene glycol

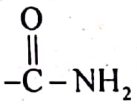

$HOCH_2CH(OH)CH_2OH$

Glycerol

Q.23

$-NH_2$ (Amino) $>C=NH$ (Imino)

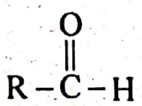
$-C\equiv N$ (Cyano)



$-\overset{\overset{O}{\|}}{C}-NH_2$ (Amide)

Q.24 Alcohols have OH-group as a functional group

Q.25 In aldehyde group, carbonyl carbon is linked with one H and one R group



$R-\overset{\overset{O}{\|}}{C}-H$

Q.26 Urea is organic compound which belongs to amide class

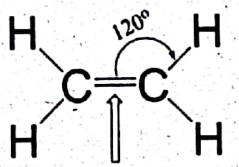
Q.27 Intermixing of one 2s and one 2p give two sp hybridized orbitals

Q.28 In sp^2 hybrid orbital

% of s character =1/3 x 100= 33.3%

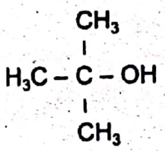
Q.29 In sp^3 % of p character = 3/4 x 100= 75%

Q.30



no rotation

Q.31

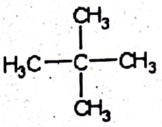


$H_3C-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-OH$

t-Butyl Alcohol

Q.32

Neopentane

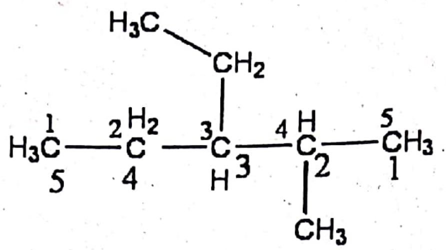


$H_3C-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-CH_3$

2,2-Dimethylpropane

Q.33 Propene is alkene which has general formula C_nH_{2n} and Propyne is alkyne with general formula C_nH_{2n-2}

Q.34



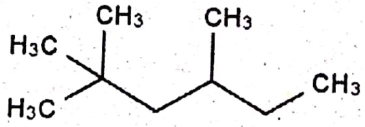
3-ethyl-2-methylpentane

Q.35 No. of isomers of some alkanes are given

No. of carbon atoms in alkane	No. of isomers
4	2
5	3
6	5

Q.36 In some cases, isopropyl is considered as a branch in large chain hydrocarbons

Q.37



Q.38 The IUPAC name for carboxylic acid is used as alkanoic acid. The suffix is -oic

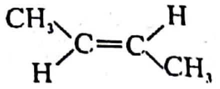
Q.39 Functional group is given priority in nomenclature

Q.40 Aromatic compounds usually have some common name to identify them easily

EXPLANATORY NOTES

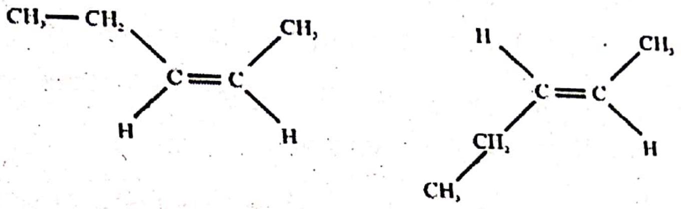
(PAST PAPER QUESTIONS)

Q.1 1-chloroproane and 2-chloropropane are positional isomers of each other.

Q.2  this is trans structure and can be converted into cis form.

Q.3

A)

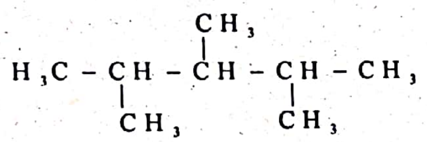


This pair shows cis-trans isomerism.

Q.4 $CH_3-CO-CH_2-CH_3$ this structure is the representation of ketone.

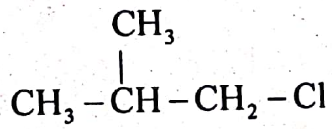
Q.5 The given compounds are aromatic hydrocarbon.

Q.6 The structural formula of 2,3,4 trimethylpentane is given below.



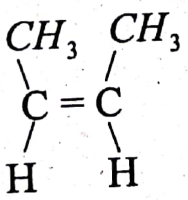
$$H_3C-\underset{\displaystyle CH_3}{CH}-\overset{\displaystyle CH_3}{CH}-\underset{\displaystyle CH_3}{CH}-CH_3$$

Q.7 The IUPAC name of the given compound is 1–Chloro-2-methylpropane

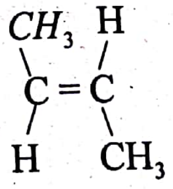


$$CH_3-\overset{\displaystyle CH_3}{CH}-CH_2-Cl$$

Q.8 The given structure show cis trans isomerism



cis-isomer



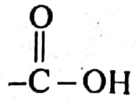
trans-isomer

Q.9 The type of structural isomerism which arises due to the difference in the nature of carbon chain or carbon skeleton is chain isomerism.

Q.10 2-chloro-3-methyl hexane is the IUPAC name of given structure.

Q.11 Cyclobutane is type of alicyclic hydrocarbons.

Q.12 1-bromo-2-chloropropene and 2,3-dimethylpropene both compounds can show geometric isomerism.

Q.13 The correct representation of functional group of carboxylic acid is  $-\overset{O}{\overset{\|}{C}}-OH$

Q.14 Butane has 2 isomers, n-butane and iso-butane.

Q.15 CH_3-CH_2-OH is the structural formula of alcohol.

Q.16 In the given compounds, alcohols have all sp^3 hybrid carbons.

Q.17 2,3,5-Trimethylhexane is the IUPAC name of given compound.

Q.18 IUPAC name of divinylacetylene is 1,5- hexadiene-3-yne ($CH_2=CH-C\equiv C-CH=CH_2$)

Q.19 Diethyl ether and n-butanol are functional group isomers of each other.

Q.20 There are 3 isomers of pentane i.e. n-pentane, iso-pentane and neo-pentane.

Q.21 Ammonical liqour is not a source of organic compounds.

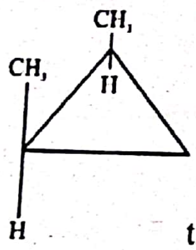
Q.22 $C_4H_{11}N$ can show metamerism ($CH_3-CH_2-NH-CH_2-CH_3$ and $CH_3-NH-CH_2-CH_2-CH_3$)

Q.23 Secondary alcohol, nitrile & aryl ring are present as functional groups in the given structure.

Q.24 C_6H_6 belongs to arene family.

Q.25 The type of isomerism existing in a compound of molecular formula C_2H_6O is functional group isomerism i.e. ethanol and dimethyl ether.

Q.26



this compound can show geometric isomerism.

Q.27 C_nH_{2n} is the general formula of cyclo alkanes as well as alkenes.

Q.28 All carbons in alkanes are sp^3 hybrid.

Topic
14

CHEMISTRY OF HYDROCARBONS

PRACTICE EXERCISE

Q.1 The extent of halogenation of alkanes depends upon the factors:
A. Intensity of UV light
[✓ B. Concentration of X_2 used]
C. Temperature
D. Both A and B

Q.2 Propagation of free radical mechanism takes place by the
A. Reaction of free radical with free radical
B. Formation of two free radicals
[✓ C. Consumption as well as production of another free radical]
D. Reaction between two molecules

Q.3 The termination step in chlorination of methane in presence of diffused sun light is
A. $Cl_2 \longrightarrow 2\dot{Cl}$
B. $CH_4 + \dot{Cl} \longrightarrow \dot{C}H_3 + HCl$
[✓ C. $Cl_2\dot{C}H + \dot{Cl} \longrightarrow HCCl_3$]
D. $H_3\dot{C} + Cl_2 \longrightarrow H_3CCl + \dot{Cl}$

Q.4 The most probable products are ________ when Cl_2 is supplied in very high excess to react with CH_4:
A. $CH_3Cl+HCl$
B. $CHCl_3+3HCl$
C. CH_2Cl_2+2HCl
[✓ D. CCl_4+4HCl]

Q.5 Halogenation of alkane is believed to proceed through
[✓ A. Free radical substitution mechanism]
B. Nucleophilic addition mechanism
C. Electrophilic substitution mechanism
D. Nucleophilic substitution mechanism

Q.6 The ease of dehydration of alcohols to produce alkenes is of the order:
[✓ A. Tertiary > Secondary > Primary]
B. Primary > Secondary > Tertiary
C. Secondary < Primary < Tertiary
D. Tertiary < Secondary < Primary

Q.7 Dehydration of alcohols with conc. H_2SO_4 at 180°C gives:
A. Ethers
B. Esters
[✓ C. Alkenes]
D. Alkyl halides

Q.8 Elimination of a halogen atom together with a hydrogen atom from an alkyl halide produces:
A. Alkanes
[✓ B. Alkenes]
C. Alkynes
D. Alcohols

Q.9 Dehydrohalogenation of RX occurs in the presence of
[✓ A. An alcoholic base]
B. An alcoholic acid
C. An alcoholic salt
D. An alcoholic Grignard reagent

Q.10 Which of the following is not used for the dehydration of alcohols?
A. P_4O_{10}
[✓ B. HNO_3]
C. H_2SO_4
D. H_3PO_4

Q.11 What type of reaction occurs between ethene and hydrogen?
[✓ A. Addition]
B. Neutralization
C. Dehydration
D. Oxidation

Q.12 Which of the following will decolorize bromine water?
A. 1-Pentene
B. Pentane
C. 2-Methyl-1-butene
[✓ D. Both "A" and "C"]

Q.13 Which of the following test can be used for distinguishing an alkane and an alkene
A. Bromine water test
B. Hydroxylation
C. Ozonolysis
[✓ D. Both "A" and "B"]

Q.14 Hydroxylation of alkenes produce
A. Diols
[✓ B. Vicinal diols]
C. Geminal diols
D. Mono-ols

Q.15 The preparation of vegetable ghee involves
A. Halogenation
[✓ B. Hydrogenation]
C. Hydroxylation
D. Dehydrogen

ethane

Q.16 The test for unsaturation of organic compounds is carried out by treating alkenes with 1% dilute alkaline $KMnO_4$ solution. The colour of $KMnO_4$ is discharged with the formation of
A. Ethylene glycol ✓
[✓ B. Vicinal glycol]
C. Glyoxal
D. Oxalic acid

Q.17 In which addition reaction Markownikov's rule is not obeyed:
A. $CH_3CH = CH_2 + HCl \rightarrow$
B. $CH_3CH_2CH = CH_2 + HI \rightarrow$
C. $CH_3CH = CH_2 + HBr \rightarrow$
[✓ D. $CH_3CH = CHCH_3 + HBr \rightarrow$]

Q.18 In addition of HCl to $CH_3CH = CH_2$, which one will be added first:
A. Cl^+
B. Cl^{-1}
[✓ C. H^+]
D. $H^\bullet$

Q.19 Which of the following is mono-ene
A. 1,3-Butadiene
B. 1-Butyne
[✓ C. 1-Butene]
D. 1,2-Butadiene

Q.20 Baeyer's reagent is used in the laboratory for
A. Reduction
B. Oxidation
[✓ C. Detection of double bond]
D. Detection of glucose

Q.21 The only alkyne which gives an aldehyde upon addition of water
[✓ A. Ethyne]
B. Propyne
C. 1-butyne
D. 2-butyne

Q.22 Which of the following is not acidic in nature
A. Ethyne
B. Propyne
C. 1-butyne
[✓ D. 2-butyne]

Q.23 Which of the following is most reactive to give electrophilic addition reactions
A. Alkane
[✓ B. Alkene]
C. Benzene
D. Alkyne

Q.24 Acetone is prepared by the hydration of
A. Ethyne
[✓ B. Propyne]
C. Ethane
D. Propane

Q.25 Acetylene gives ________ precipitates with $AgNO_3$ in ammonium hydroxide solution
[✓ A. White]
B. Red
C. Orange
D. Yellow

Q.26 Which of the following compound reacts with sodium to yield hydrogen gas
A. $CH_3–CH_3$
B. $CH_3 – CH = CH_2$
[✓ C. $CH \equiv CH$]
D. $CH_3 – C \equiv C–CH_3$

Q.27 Total number of hybrid orbitals of all the carbon atoms in benzene are:
A. 3
B. 6
C. 12
[✓ D. 18]

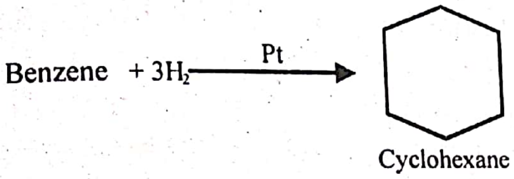
Q.28 The resonance energy of benzene is
A. –119.5kJ/mole
[✓ B. –358.5kJ/mole]
C. +150.5kJ/mole
D. –208kJ/mole

Q.29 **How many π electrons are there in benzene to form delocalized electronic cloud?**
A. 3
B. 4
C. 8
[✓ D. 6]

Q.30 **What is required other than anhydrous $A\ell C\ell_3$, when toluene is prepared by Friedal craft reaction?**
A. C_6H_6
[✓ B. $C_6H_6 + CH_3C\ell$]
C. $C_6H_5C_2H_5$
D. $C_6H_5C\ell$ and CH_3Cl

Q.31 **Which of the following is produced by the action of CH_3Cl on benzene in presence of $AlCl_3$ followed by oxidation in the presence of acidified $KMnO_4$ give**
A. Toluene
B. o-Xylene
C. m-Xylene
[✓ D. Benzoic acid]

Q.32 **The conversion of benzene into cyclohexane is ________**
[✓ A. Exothermic process]
B. Isothermic process
C. Endothermic process
D. Both A and B



Q.33 **This reaction is an example of:**
[✓ A. Addition reaction]
B. Substitution reaction
C. Elimination reaction
D. Polymerization

Q.34 **X is decolourized when alkyl benzene are readily oxidized to benzoic acid, X is**
A. Aqueous $KMnO_4$ or $K_2Cr_2O_7$
B. Cold dilute alkaline $KMnO_4$ or $K_2Cr_2O_7$
C. Alcoholic $KMnO_4$ or $K_2Cr_2O_7$
[✓ D. Acidified $KMnO_4$ or $K_2Cr_2O_7$]

Q.35 **Benzoic acid is the only oxidation product along with formation H_2O and CO_2, of an organic compound A, when A is treated with acidified potassium dichromate, A is**
[✓ A. Ethyl benzene]
B. Benzoyl halide
C. Aniline
D. Benzophenone

Q.36 **Benzoic acid is the main product when ________ is oxidized by acidified $K_2Cr_2O_7$**
A. $C_6H_5CH_3$
B. $C_6H_5CH_2CH_2CH_3$
C. $C_6H_5CH_2CH_3$
[✓ D. All of these]

Q.37 **The oxidation of toluene by acidified $KMnO_4$ produces**
A. Phenol
B. Benzaldehyde
C. Benzyl alcohol
[✓ D. Benzoic acid]

Q.38 **Most reactive compound among the following:**
A. Benzene
B. Benzoic acid
C. Nitrobenzene
[✓ D. Ethyl benzene]

Q.39 **Which group deactivates the benzene ring?**
A. $-NH_2$
[✓ B. $-CHO$]
C. $-OR$
D. $-OH$

Q.40 $X \xrightarrow[FeCl_3]{Cl_2} Y \xrightarrow{HNO_3+H_2SO_4} Z$, **Z in this reaction is possibly**
A. Benzene
B. Chlorobenzene
C. 3-Chloronitrobenzene
[✓ D. 2-Chloronitrobenzene]

PAST PAPER QUESTIONS

Q.1 When hydrogen atom is removed from benzene, group left is called: MDCAT (2010)

A. Alkyl group
[✓ B. Phenyl group]
C. Benzyl group
D. Methyl group

Q.2 The introduction of NO_2 group in the benzene ring is called nitration. The nitration of benzene takes place when it is heated with a 1:1 mixture of ---------- at 50-55°C MDCAT (2010)

[✓ A. Conc. HNO_3 and Conc. H_2SO_4]
B. Conc. HNO_3 and Conc. HCl
C. Conc. HNO_3 and Conc. Acetic acid
D. Conc. HNO_3 and Conc. H_3PO_4

Q.3 Ethyne molecule is formed when two carbon atoms joined together to form a sigma bond only: MDCAT (2010)

A. sp-s overlap
[✓ B. sp-sp overlap]
C. sp^2-sp^2 overlap
D. 2py-2py overlap

Q.4 Hydrogenation of unsaturated oils is done by using MDCAT (2011)

[✓ A. Finely divided nickel]
B. Finely divided iron
C. Vanadium pentaoxide
D. Copper

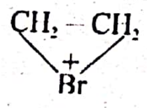
Q.5 The substitution of –H group by –NO_2 group in benzene is called MDCAT (2011)

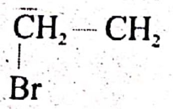
[✓ A. Nitration]
B. Ammonolysis
C. Sulphonation
D. Reduction of benzene

Q.6 Benzene in presence of $AlCl_3$ gives acetophenone when reacts with MDCAT (2011)

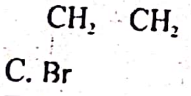
[✓ A. Acetyl chloride]
B. Acetic acid
C. Ethyl benzene
D. Ethanoic acid

Q.7 In the reaction of ethene with bromine the intermediate formed is MDCAT (2012)

[✓ A.]


B.


$\underset{|}{CH_2}-CH_2$ Br

C.


$CH_2 \quad CH_2$ Br

D. $CH_2=CHBr$

Q.8 Ethene on polymerization, give the product polyethene, this reaction may be called as MDCAT (2012)

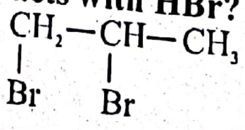
[✓ A. Addition]
B. Substitution
C. Condensation
D. Pyrolysis

Q.9 The introduction of $R-\overset{\overset{\displaystyle O}{\|}}{C}$ group in benzene is called MDCAT (2012)

[✓ A. Acylation]
B. Alkylation
C. Carbonyl reduction
D. Formylation

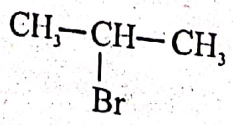
Q.10 What is the product formed when propene reacts with HBr? MDCAT (2013)

A. $CH_3-CH_2-CH_2Br$

B.


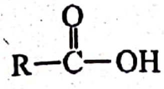
$\underset{\displaystyle Br}{\underset{|}{CH_2}}-\underset{\displaystyle Br}{\underset{|}{CH}}-CH_3$

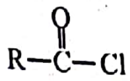
C. $BrCH_2-CH=CHBr$

[✓ D.]


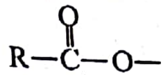
$CH_3-\underset{\displaystyle Br}{\underset{|}{CH}}-CH_3$

Q.11 The introduction of an alkyl group in benzene takes place in the presence of $AlCl_3$ and: MDCAT (2013)

A. 
$R-\overset{O}{\overset{\|}{C}}-OH$

B. 
$R-\overset{O}{\overset{\|}{C}}-Cl$

[✓ C. R—Cl]

D. 
$R-\overset{O}{\overset{\|}{C}}-O-$

Q.12 Addition of unsymmetrical reagent to an unsymmetrical alkene is governed by: MDCAT (2014)

A. Cannizzaro's Reaction

B. Aldol condensation

C. Krichoff Rule

[✓ D. Markownikov's Rule]

Q.13 Order of reactivity of alkenes with hydrogen halide is MDCAT (2015)

A. HBr > HI > HCl

B. HF > HI > HCl

C. HI > HBr > HF

[✓ D. HI > HBr > HCl]

Q.14 Which one of the following is a powerful electrophile used to attack on the electrons of benzene ring? MDCAT (2015)

A. $FeCl_2$

[✓ B. Cl^+]

C. $FeCl_4^-$

D. Cl_2

Q.15 The reaction of benzene with bromine in the presence of $FeBr_3$ follows the mechanism of ________ reaction MDCAT (2017)

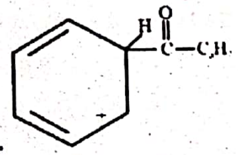
A. Electrophilic addition

[✓ B. Electrophilic substitution]

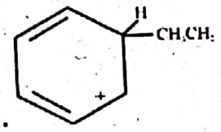
C. Nucleophilic substitution

D. Nucleophilic addition

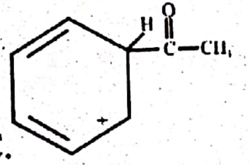
Q.16 Intermediate product formed when propanoyl chloride reacts with benzene is MDCAT (2017)



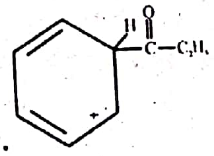
A.



B.



C.



[✓ D.]

Q.17 When benzene reacts with Acetyl chloride (CH_3COCl) in the presence of $AlCl_3$ acetophenone is formed. The electrophile in this reaction will be MDCAT (2017)

[✓ A. CH_3C^+O]

B. C^+H_3

C. $AlCl_3$

D. CH_3COCl

Q.18 Which of the following species are 3,5(meta directing groups when second group is introduced into the benzene ring MDCAT (2017)

I = –NH_2 II = –CHO III = –COOH IV = –CH_3

A. II, III and IV

B. I and IV

[✓ C. II and III]

D. I, II and IV

Q.19 For halogenation of benzene, which reagent is used: MDCAT (2017)

A. H_2SO_4

B. HNO_3

[✓ C. $AlCl_3$]

D. HCl

Q.20 Chlorination and Bromination mostly uses: MDCAT (2017)

A. Radiowaves

B. Infrared radiation

C. Visible light

[✓ D. U.V light]

Q.21 Among the following, which one has electron withdrawing effect: **MDCAT (2017)**

A. $-NH_2$
●. -CHO
C. $-N(CH_3)_2$
D. –I

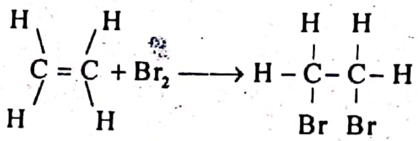
Q.22 Reaction mechanism of alkanes with halogens is known as **MDCAT (2018)**

A. Addition
B. Elimination
●. Free radical substitution
D. Propagation

Q.23 Which compound is obtained by the elimination of bromopropane? **MDCAT (2018)**

A. Butene
●. Propene
C. Ethene
D. Propane

Q.24 Bromination of alkene is shown in the following reaction. This reaction is used for: **MDCAT (2018)**



A. Identification of primary and secondary alcohols
●. Detection of double bond
C. Detection of aldehydes
D. Detection of ketones

Q.25 Which one of the following acts as a electrophile in the electrophilic substitution of benzene with bromine **MDCAT (2018)**

●. Br^+
B. $FeCl_4^-$
C. Fe^{+3}
D. Fe^{+2}

Q.26 In Friedal Craft's Chlorination of Benzene, Iron III chloride acts as a catalyst, which is the initial reaction in the generation of an electrophile? **SET (2019)**

A. $Cl_2 + FeCl_3 \rightarrow Cl^+ + FeCl_3^-$
B. $Cl_2 + FeCl_3 \rightarrow 2Cl^+ + FeCl_2^-$
C. $Cl_2 + FeCl_3 \rightarrow Cl^- + FeCl_4^+$
●. $Cl_2 + FeCl_3 \rightarrow Cl^+ + FeCl_4^-$

Q.27 Which of the options show all possible products of combustion of Butene? **SET (2019)**

A. $CO+CO_2+H_2O$
B. CO_2+H_2O
C. $C+CO+CO_2$
●. $C+CO+CO_2+H_2O$

Q.28 In the reaction sequence given here $H_3C-CH_3+Br_2 \xrightarrow{h\nu} A \xrightarrow{AlcKOH} B$ **The end product is an unsaturated hydrocarbon. Identify the nature of reaction in the two steps.** **SET (2019)**

A. Step I is a nucleophilic substitution and step II is elimination
B. Step I is addition and step II is nucleophilic substitution
C. Step I is free radical substitution and step II nucleophilic substitution
●. Step I is free radical substitution and step II is elimination

Q.29 Homolysis of a covalent bond yields a very reactive species with incomplete octet in its valence shell. What is this species? **SET (2019)**

A. A complex ion
B. An electrophile
●. A free radical
D. A nucleophile

Q.30 Order of reactivity of halogen toward alkane is **NUMS (2019)**

A. $F_2>I_2>Br_2>Cl_2$
B. $F_2>Br_2>Cl_2>I_2$
●. $F_2>Cl_2>Br_2>I_2$
D. $F_2>Cl_2>I_2>Br_2$

Q.31 Acetone can be obtained by ozonolysis NUMS (2019)

A. 2-Batyne
B. 2-Butene
[✓ C. iso-butene]
D. 1-butene

Q.32 Which catalyst is used in oxidation of benzene ring? NUMS (2019)

A. $FeBr_3$
[✓ B. V_2O_5]
C. $Fe+Al_2O_3$
D. Raney Ni

Q.33 Which of the following compound react slower than benzene in electrophilic substitution reaction NUMS (2019)

[✓ A. Nitrobenzene]
B. Phenol
C. Aniline
D. Toulene

Q.34 The correct order of the reactivity of hydrocarbon given below is ETEA (2016)

[✓ A. $C_2H_4 > C_2H_2 > C_6H_6$]
B. $C_6H_6 > C_2H_4 > C_2H_2$
C. $C_2H_4 > C_2H_4 > C_6H_6$
D. $C_2H_2 > C_6H_6 > C_2H_4$

Q.35 Select meta directing group of the following? ETEA (2016)

A. –OH
B. $-NR_2$
[✓ C. –CN]
D. –OR

Q.36 A gas decolorizes alkaline $KMnO_4$ solution but does not give any PPT with ammonical $AgNO_3$ ETEA (2019)

A. Methane
[✓ B. Ethylene]
C. Ethane
D. None of the above

Q.37 An olefin "X" on ozonolysis gives $CH_3CH_2COCH_3$and CH_3COCH_3. The IUPAC name of X is: ETEA (2019)

A. 2-butane
[✓ B. 2-3 di methyl-2-pentene]
C. 2-pentene
D. 1-Hexene

Q.38 Treatment of ethene with cold sulphuric acid followed by reaction with boiling water yields: MDCAT (2019)

A. Ethyne
B. Ethane
C. Ethanal
[✓ D. Ethanol]

Q.39 Alkenes undergo: MDCAT (2019)

A. Nucleophilic substitution
[✓ B. Electrophilic Addition]
C. Nucleophilic addition
D. Electrophilic substitution

Q.40 Which of the following molecule shows cis – trans isomers? MDCAT (2019)

A. C_2HCl_3
B. $C_2H_2Cl_4$
C. C_2H_4
[✓ D. $C_2H_2Br_2$]

Q.41 In the reaction sequence: MDCAT (2019)

$$H_3C-CH_2-CH_2-Br + AlcKOH \longrightarrow C \xrightarrow[H_2O]{H_2SO_4} D$$

Product D will be

A. Mixture of methanol and ethanol
[✓ B. 2-propanol]
C. 1-Propanol
D. Propanoic acid

Q.42 Which of the following reactions is used for the production of alcohols on industrial scale? MDCAT (2019)

A. Hydrohalogenation of alkenes
[✓ B. Hydration of alkenes]
C. Hydroxylation of alkenes
D. Hydrogenation of alkenes

Q.43 Which derivative of benzene shows maximum reactivity in electrophilic substitution reactions? **MDCAT (2019)**

A. Benzaldehyde [✓ B. Methyl benzene]
C. Benzoic acid D. Nitrobenzene

Q.44 Electrophile in sulphonation of benzene is **NMDCAT (2020)**

A. HSO_4 B. H_2SO_4
[✓ C. SO_3] D. HSO_3

Q.45 Acetophenone can be formed by which of the following reaction of benzene? **NMDCAT (2020)**

A. Alkylation [✓ B. Acylation]
C. Halogenation D. Nitration

Q.46 When CH_3 is attached with the benzene ring, it makes the ring: **NMDCAT (2020)**

A. Good electrophile [✓ B. Good nucleophile]
C. Resonance hybrid D. Extraordinary stable

ANSWER KEY

1	B	11	A	21	A	31	D
2	C	12	D	22	D	32	A
3	C	13	D	23	B	33	A
4	D	14	B	24	B	34	D
5	A	15	B	25	A	35	A
6	A	16	B	26	C	36	D
7	C	17	D	27	D	37	D
8	B	18	C	28	B	38	D
9	A	19	C	29	D	39	B
10	B	20	C	30	B	40	D

PAST PAPER QUESTIONS

1	B	6	A	11	C	16	D	21	B	26	D	31	C	36	B	41	B	46	B
2	A	7	A	12	D	17	A	22	C	27	D	32	B	37	B	42	B		
3	B	8	A	13	D	18	C	23	B	28	D	33	A	38	D	43	B		
4	A	9	A	14	B	19	C	24	B	29	C	34	A	39	B	44	C		
5	A	10	D	15	B	20	D	25	A	30	C	35	C	40	D	45	B		

EXPLANATORY NOTES»

Q.1

$$CH_4 + X_2 \longrightarrow CH_3X + HX$$

$$CH_4 + 2X_2 \longrightarrow CH_2X_2 + 2HX$$

$$CH_4 + 3X_2 \longrightarrow CHX_3 + 3HX$$

$$CH_4 + 4X_2 \longrightarrow CX_4 + 4HX$$

A. and C. control rate of reaction.

Q.2 Propagation step involves

i) Attack of free radical on molecule
ii) Homolytic fission in molecule
iii) Bond formation
iv) Formation of new molecule
v) Formation of new free radical

$$R^\circ + Cl_2 \longrightarrow R - Cl + Cl^\circ$$

$$Cl^\circ + R - H \longrightarrow HCl + R^\circ$$

Q.3 Termination step in free radical substitution mechanism involves

i) Attack of free radical on other free radical
ii) Bond formation
iii) Formation of a molecule

$$Cl^\circ + Cl^\circ \longrightarrow Cl_2$$

$$R^\circ + X^\circ \longrightarrow R - X$$

$$R^\circ + R^\circ \longrightarrow R - R$$

Q.4

$$CH_4 + Cl_2 \longrightarrow CH_3Cl + HCl$$

$$CH_3Cl + Cl_2 \rightarrow CH_2Cl_2 + HCl$$

$$CH_2Cl_2 + Cl_2 \rightarrow CHCl_3 + HCl$$

$$CHCl_3 + Cl_2 \rightarrow CCl_4 + HCl$$

Q.5 The initiation propagation and termination of halogenation of alkane involves free radicals.

Initiation step $Cl_2 \longrightarrow 2Cl^\circ$

Propagation step $Cl^\circ + CH_4 \longrightarrow HCl + \overset{\circ}{C}H_3$

Termination step $\overset{\circ}{C}H_3 + Cl^\circ \longrightarrow CH_3Cl$

Q.6 The dehydration of alcohols is an elimination reaction which involves $C - O$ cleavage.

Ease of dehydration $\propto$ Ease of $C - O$ cleavage $\propto$ number of β - carbon in alcohol.

$3\ \beta - C$ in tertiary alcohol, $2\ \beta - C$ in secondary alcohol and $1\ \beta - C$ in primary alcohol.

Ease of dehydration $\propto$ Ease of $C - O$ cleavage $\propto$ Size of R in alcohol

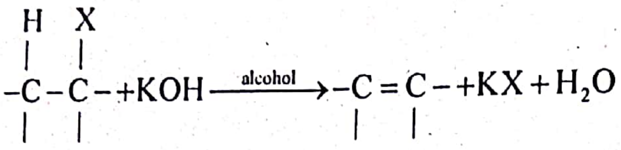
Q.7 Concentration H_2SO_4 180°C causes β-elimination reaction

$$C_2H_5OH \xrightarrow[180^\circ C]{conc.H_2SO_4} H_2C=CH_2+H_2O$$

But concentration H_2SO_4 causes condensation elimination reaction at 140°C.

$$2C_2H_5OH \xrightarrow[140^\circ C]{conc.H_2SO_4} C_2H_5-O-C_2H_5$$

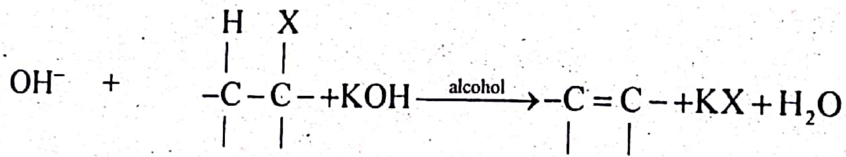
Q.8 This is β-elimination reaction which involves removal of X from α–C and removal of β–H from β–C.



$$\begin{array}{c}H\ \ X\\ |\ \ \ |\\ -C-C-\\ |\ \ \ |\end{array}+KOH \xrightarrow{alcohol} \begin{array}{c}-C=C-\\ |\ \ \ \ |\end{array}+KX+H_2O$$

Dehalogenation is removal of X from α–C and β–H from β–C.

Q.9 In alcoholic medium OH becomes strong base hence it attacks on β–H instead of replacing X from RX. Therefore, alkene is produced from RX by β-elimination reaction.



$$OH^- \quad + \quad \begin{array}{c}H\ \ X\\ |\ \ \ |\\ -C-C-\\ |\ \ \ |\end{array}+KOH \xrightarrow{alcohol} \begin{array}{c}-C=C-\\ |\ \ \ \ |\end{array}+KX+H_2O$$

Q.10 Dehydration of alcohols need dehydrating agents like concentrated H_2SO_4, P_2O_3 or P_4O_{10}, H_3PO_4 and Al_2O_3.

HNO_3 is not a dehydration agent at all.

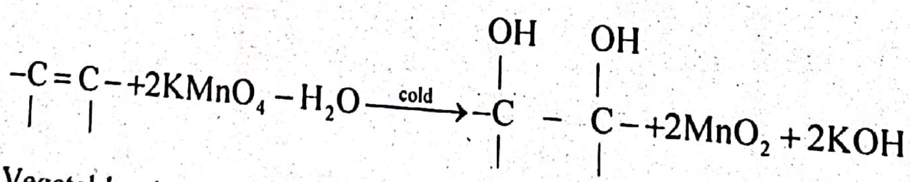
Q.11 Ethene is an unsaturated hydrocarbon. So, it becomes saturated, reduced by the addition of hydrogen gas.

$$C_2H_4+H_2 \xrightarrow[\Delta]{Ni} C_2H_6$$

Q.12 Bromine water ($Br_{2(aq)}$) is reddish brown in colour. It is used to detect unsaturation in hydrocarbon when any unsaturated hydrocarbon (1-Pentene / 2-Methyl-1-pentene) come across it. Bromine water is decolourized.

Q.13 Alkane is saturated hydrocarbon while alkene is an unsaturated one. The presence of unsaturation is detected by bromine water test and hydroxylation (using Baeyer's reagent). Ozonolysis is used to locate position of double bond.

Q.14

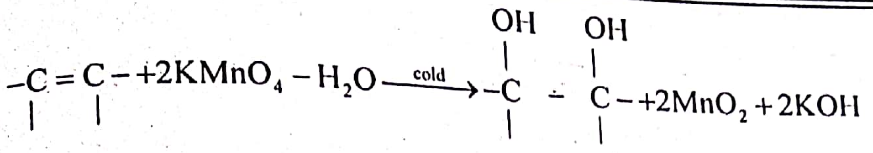


$$\begin{array}{c}-C=C-\\ |\ \ \ \ |\end{array}+2KMnO_4-H_2O \xrightarrow{cold} \begin{array}{c}OH\ \ \ OH\\ |\ \ \ \ \ \ |\\ -C\ -\ C-\\ |\ \ \ \ \ \ |\end{array}+2MnO_2+2KOH$$

Q.15 Vegetable ghee is prepared from vegetable oil which is tri-ester of unsaturated fatty acids with glycerol.

The unsaturation can be vanished by hydrogenation in presence of Ni at high temperature.

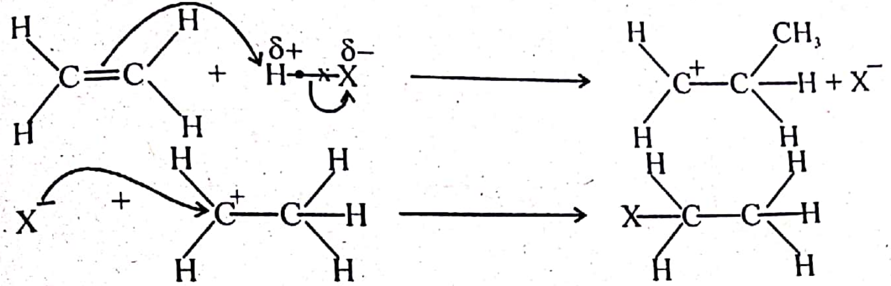
Q.16



$$-\underset{|}{C}=\underset{|}{C}-+2KMnO_4-H_2O\xrightarrow{\text{cold}}-\overset{\overset{OH}{|}}{\underset{|}{C}}-\overset{\overset{OH}{|}}{\underset{|}{C}}-+2MnO_2+2KOH$$

Q.17 Markownikove's rule is obeyed by unsymmetrical alkenes. Symmetrical alkanes like $CH_3CH = CHCH_3$ having no binding to obey the rule because both doubly bonded carbon atoms have same number of hydrogen atom.

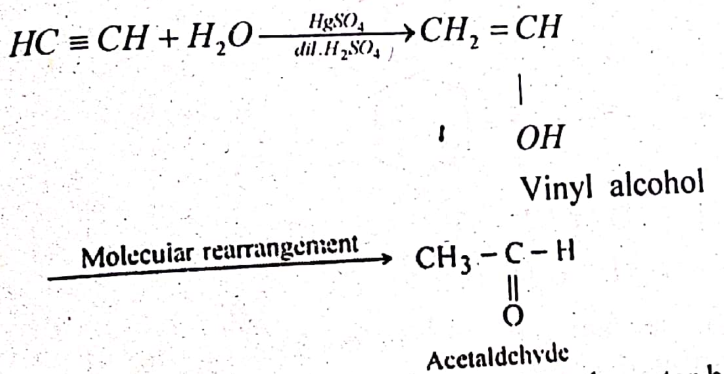
Q.18 In case of alkenes, the addition is started by the attack of electrophile.



Q.19 The alkene which contains only one double bond is called monoene.

Q.20 Alkaline $KMnO_4$ is called Baeyer's reagent which is used in the laboratory for the detection of double bond.

Q.21



$$HC\equiv CH+H_2O\xrightarrow[\text{dil.}H_2SO_4]{HgSO_4}\underset{\underset{OH}{|}}{CH_2=CH}$$

Vinyl alcohol

$$\xrightarrow{\text{Molecular rearrangement}}CH_3-\underset{\underset{O}{\|}}{C}-H$$

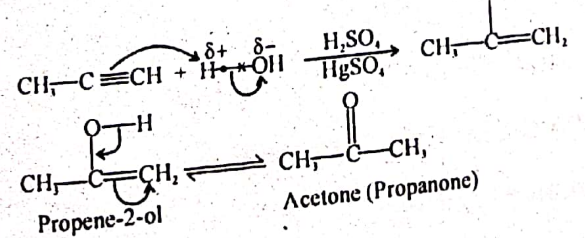
Acetaldehyde

Q.22 Only terminal alkynes show the acidic character because sp hybridized carbon atoms of a terminal alkyne pulls the elelctrons more strongly making the attached hydrogen atom slightly acidic. 2-Butyne is not acidic because it is not terminal alkyne.

Q.23 Reactivity order of alkane, alkene and alkyne is given below

Alkene > Alkyne > Alkane

Q.24



Q.25

$$HC\equiv CH+2AgNO_3+2NH_4OH\longrightarrow \overset{+}{Ag}\,\overset{-}{C}\equiv\overset{-}{C}\,\overset{+}{Ag}+2NH_4NO_3+2H_2O$$

Silver acetylide
(White ppt.)

Q.26

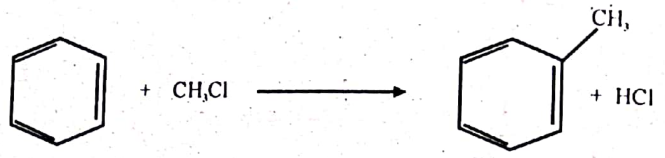
$$\underset{\text{Acetylene}}{HC\equiv CH} + 2Na \longrightarrow \underset{\text{Sodium acetylide}}{\overset{+}{Na}\,\overset{-}{C}\equiv\overset{-}{C}\,\overset{+}{Na}} + H_2$$

Q.27 Benzene consists of six sp^2-hybridized carbon atoms each sp^2-carbon atoms has $3sp^2$ hybrid orbital therefore the total number of hybrid orbitals in benzene would be 18.

Q.28 Resonance energy of benzene is $+150.5\ kJmol^{-1}$

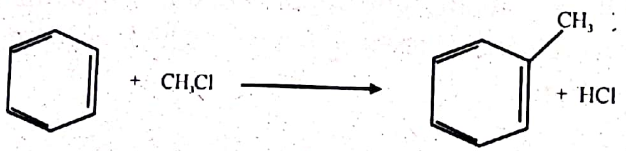
Q.29 In benzene all six carbon atoms are sp^2-hybridized, so each carbon atom is having one half filled un-hybrid orbital that is involved in partial overlap with adjacent un-hybrid orbitals of p to form π–electrons cloud of 6 electrons.

Q.30 In Friedal Craft's reaction $AlCl_3$ is a catalyst. It accelerates the reaction between C_6H_6 an R–X like CH_3Cl.

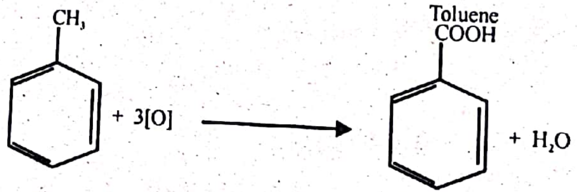


Toluene

Q.31



Toluene



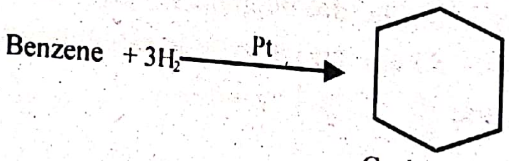
Benzoic acid

$$C_6H_6 + C_6H_5COCl \xrightarrow{AlCl_3} C_6H_5-CO-C_6H_5 + HCl$$

$$C_6H_6 + CH_3CH_2CH_2-Cl \xrightarrow{AlCl_3} C_6H_5-C_3H_7 + HCl$$

Q.32 The conversion of benzene to cyclohexane is hydrogenation. This process of hydrogenation is an exothermic as it gives out 208kJ/mol of energy.

Q.33



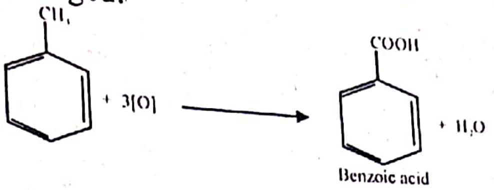
Cyclohexane

Theoretical value = -358.5 kJ/mole (calculated heat of hydrogenation)

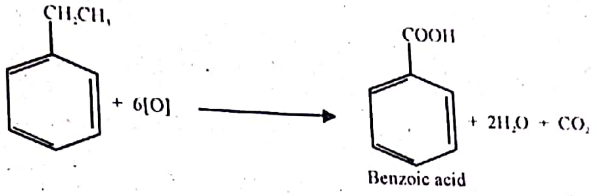
Experimental value = -208.0 kJ/mole (observed heat of hydrogenation)

Difference = -150.5 kJ/mole (resonance energy)

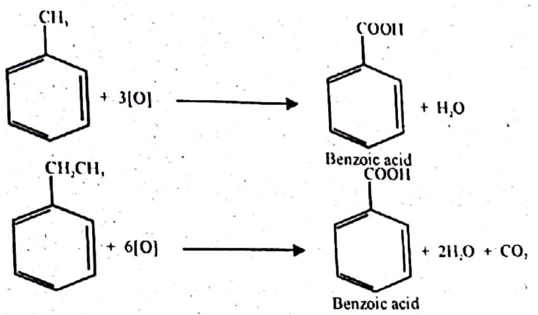
Q.34 Alkyl benzenes are oxidized to benzoic acid by nascent oxygen which is produced by reacting purple coloured $KMnO_4$ with H_2SO_4 or orange red coloured $K_2Cr_2O_7$ during this production colour is discharged.



Q.35

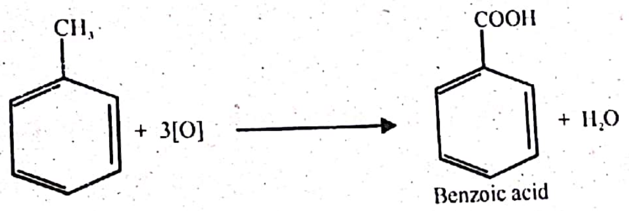


Q.36



Whatever the length of an alkyl group may be, it gives only one carboxyl group. Moreover the colour of $KMnO_4$ is discharged. Therefore, this reaction is used as a test **for alkylbenzenes.**

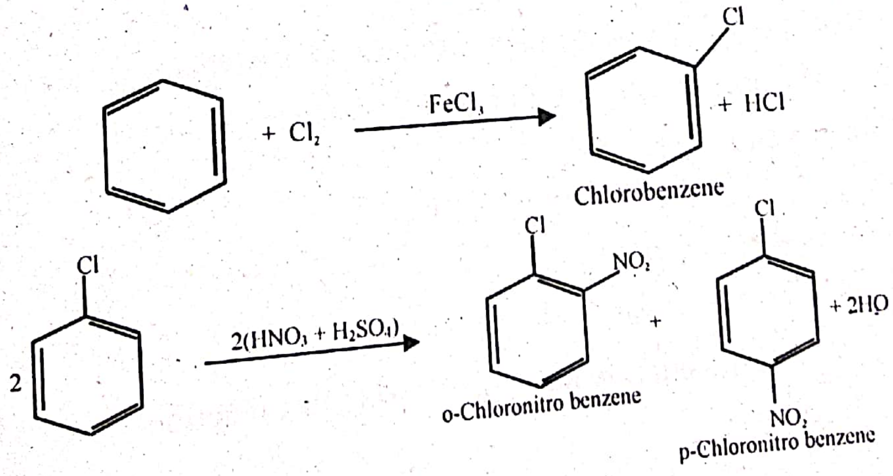
Q.37



Q.38 In ethyl benzene, ethyl group is ortho, para directing groups which activate the benzene ring.

Q.39 -CHO is meta directing group which deactivates the benzene rings While $-NH_2$, -OR and –OH activate the benzene ring.

Q.40



EXPLANATORY NOTES

(PAST PAPER QUESTIONS)

Q.1 When hydrogen atom is removed from benzene, group left is called phenyl group.

Q.2 Conc. HNO_3 and Conc. H_2SO_4 (nitrating mixture) is used for introduction of nitro group.

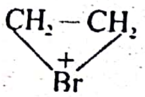
Q.3 In ethyne only sp-sp overlap gives sigma bond between carbon atoms.

Q.4 Hydrogenation of unsaturated oils is done by using finely divided Ni.

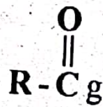
Q.5 The substitution of –H group by $-NO_2$ group in benzene is called nitration.

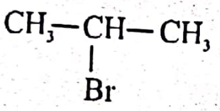
Q.6 Acetyl chloride and benzene reacts to give acetophenone in the presence of $AlCl_3$ catalyst.

Q.7 In the reaction of ethene with bromine the intermediate formed is brominium ion



Q.8 Ethene on polymerization, give the product polyethene, this reaction may be called as addition reaction.

Q.9 The introduction of  $R-\overset{\overset{O}{\parallel}}{C}$ group in benzene is called Friedel craft acylytion.

Q.10  $CH_3-\underset{\underset{Br}{|}}{CH}-CH_3$ is the product formed when propene reacts with HBr folowing Markonikov rule.

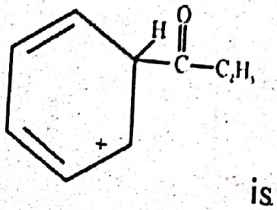
Q.11 The introduction of an alkyl group in benzene takes place in the presence of $AlCl_3$ &R-Cl

Q.12 Addition of unsymmetrical reagent to an unsymmetrical alkene is governed by markonikov rule, according to this negative part of reagent will attach to those double bonded carbon having less number of hydrogen.

Q.13 Order of reactivity of alkenes with hydrogen halide is HI > HBr > HCl due to bond energy factor.

Q.14 Cl^+ is an electrophile which can attack strongly on benzene.

Q.15 The reaction of benzene with bromine in the presence of $FeBr_3$ follows the mechanism of electrophilic substitution reaction.

Q.16  is the intermediate form during this reaction.

Q.17 When benzene reacts with Acetyl chloride (CH_3COCl) in the presence of $AlCl_3$ acetophenone is formed. The electrophile in this reaction will be $CH_3C^+=O$

Q.18 Aldehyde (-CHO) and carboxyl (-COOH) both are meta directing groups.

Q.19 For halogenation of benzene, $AlCl_3$ catalyst is used.

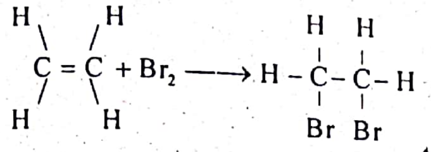
Q.20 Chlorination and Bromination mostly use U.V light.

Q.21 Aldehyde (-CHO) has electron withdrawing effect while other have electron donating.

Q.22 Reaction mechanism of alkanes with halogens is known as free radical mechanism.

Q.23 Propene is obtained by the elimination of bromopropane.

Q.24



this is used to detect the presence of double bond, in the presence of multiple bond, bromine decolourizes.

Q.25 Br^+ acts as an electrophile in the electrophilic substitution of benzene with bromine.

Q.26 $Cl_2 + FeCl_3 \rightarrow Cl^+ + FeCl_4^-$ this is the first step to produce electrophile.

Q.27 $C+CO+CO_2+H_2O$ all are possible products of butene during combustion.

Q.28 Step I is free radical substitution as alkyl bromide is produced from alkane and step II is elimination as alkene is produced from alkyl halide.

Q.29 Homolysis of a covalent bond yields a very reactive free radical with incomplete octet in its valence shell.

Q.30 $F_2>Cl_2>Br_2>I_2$ is the correct order. Fluorine is most reactive non-metal which reacts with alkanes in the absence of sunlight without heating and the order decrease down the group for halogens.

Q.31 iso-butene $(CH_3)_2C=CH_2$ will give acetone along with formaldehyde upon ozonolysis.

Q.32 V_2O_5 as catalyst is used in oxidation of benzene ring which produces maleic anhydride.

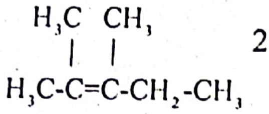
Q.33 Nitrobenzene is less reactive than benzene due to presence of deactivating meta directing NO_2^+ group.

Q.34 $C_2H_4 > C_2H_2 > C_6H_6$ is the correct order. alkenes are most reactive hydrocarbons due to presence of a pi-bond, in alkyne there are 2 pi-bonds due to which bond length decreases and bond energy increases so alkynes are less reactive, while benzene is stable and least reactive due to resonance stability.

Q.35 –CN is deactivating and meta directing group.

Q.36 Ethylene or ethene decolourizes the $KMnO_4$ due to presence of double bond but does not give positive tollen's test.

Q.37



$H_3C-\overset{H_3C}{\overset{|}{C}}=\overset{CH_3}{\overset{|}{C}}-CH_2-CH_3$

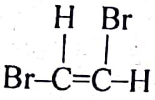
2-3 di methyl-2-pentene

This is an alkene that gives acetone and butanone upon ozonolysis.

Q.38 Treatment of ethene with cold sulphuric acid followed by reaction with boiling water yields ethanol. This is the hydration of alkene.

Q.39 Alkenes undergo electrophillic addition reaction, due to double bond it becomes electron rich (nucleophillic) and is easy breaking of pi-bond.

Q.40



$Br-\overset{H}{\overset{|}{C}}=\overset{Br}{\overset{|}{C}}-H$

$C_2H_2Br_2$ shows cis-trans isomerism.

Q.41 $H_3C-CH_2-CH_2-Br+AlcKOH \longrightarrow C \xrightarrow[H_2O]{H_2SO_4} D$ in this reaction "D" is 2-propanol.

Q.42 Hydration of alkenes are industrially used to prepare alcohol.

Q.43 Toluene (Methylbenzene) is the most reactive due to presence of activating and ortho-para directing methyl group.

Q.44 SO_3 is the electrophile in sulphonation of benzene, the neutral but strong electrophile.

Q.45 Friedel craft acylation is used to produce the acetophenone.

Q.46 CH_3 is attached with the benzene ring, it makes the ring good nucleophile because of electron donating nature of R group.

Topic
15

ALKYL HALIDES

PRACTICE EXERCISE

Q.1 Which of the following is alkyl halide

[✓ A. CH_3Cl]
B. $C_2H_4Cl_2$
C. CH_2Cl_2
D. All of these

Q.2 Which one is monohaloalkane

A. CH_2Cl_2
[✓ B. $CH_3 — CH_3 — CH_2 — Cl$]
C. $CHCl_3$
D. CCl_4

Q.3 Which of the following is primary alkyl halide

A. Iso-propyl halide
B. Sec. butyl halide
C. Ter. butyl halide
[✓ D. Neo-pentyl halide]

Q.4 Elimination bimolecular reactions involve:

A. 1st order kinetics
[✓ B. 2nd order kinetics]
C. Zero order kinetics
D. None of these

Q.5 Which one among the following is not a good leaving group?

A. HSO_4^-
B. Cl^-
[✓ C. OH^-]
D. Br^-

Q.6 Alkyl halides are considered to be very reactive compounds towards nucleophile because

A. They have an electrophilic carbon
[✓ B. They have an electrophilic carbon and a good leaving group]
C. They have an electrophilic carbon and a bad leaving group
D. They have a nucleophilic carbon and a good leaving group

Q.7 Order of S_N1 reaction

[✓ A. 1]
B. 1.5
C. 2
D. 3

Q.8 Which of the following is correct about S_N1 reactions:

A. Retention of the configuration of the alkyl halide molecule
B. Unimolecular reactions
C. Reaction rate is a function of the [alkyl halide]
[✓ D. All of these]

Q.9 β-elimination reactions are due to:

A. Attack of the incoming nucleophile on alpha hydrogen
[✓ B. Attack of the incoming nucleophile on beta hydrogen]
C. Attack of the incoming nucleophile on beta carbon
D. Attack of incoming nucleophiles on electrophilic carbon

Q.10 Tertiary alkyl halides give

[✓ A. S_N1 and E1 reaction]
B. S_N2 and E2 reaction
C. S_N2 and E1 reaction
D. None of the above

Q.11 Which of the following is correct about S_N2 reactions:

A. Breakage of C—X and formation C—Nu bonds are simultaneous
B. Inversion of the configuration of the alkyl halide molecule
C. 2nd order kinetics
[✓ D. All of these]

Q.12 Which statement is incorrect about reactivity of alkyl halides with respect to nucleophile

A. Greater the bond energy of R-X, lesser the reactivity
B. Greater the bond polarity of R-X, lesser the reactivity
[✓ C. Greater the bond energy of R-X, smaller the stability]
D. Greater E.N difference of R- X, greater the stability

Q.13 Which statement is incorrect about nucleophilic substitution reaction

A. Incoming nucleophile must be stronger than the leaving one
[✓ B. Leaving nucleophile must be stronger than incoming nucleophile]
C. Tertiary alkyl halides generally give S_N1 reactions
D. S_N2 is a single step mechanism

Q.14 In β-Elimination the resulting product is?
A. Alcohol B. Alkane
C. Alkyl halide [✓ D. Alkene]

Q.15 Which compound is most reactive through SN_2 mechanism
[✓ A. $CH_3–Cl$] B. $CH_3–CH_2–CH_2–Cl$
C. $CH_3–CH_2–Cl$ D. All have same reactivity

Q.16 Thioalcohol is prepared when alkyl halide is reacted with
A. $O\bar{H}$ [✓ B. $S\bar{H}$]
C. NO_2^- D. I^-

Q.17 Whether an alkyl halide follows SN1 or SN2 mechanism depends on
A. Steric hindrance B. Stability of carbocation
C. Inductive effect [✓ D. All of these]

Q.18 Ter. butyl bromide refers to follow which mechanism during substitution reactions
[✓ A. S_N1] B. S_N2
C. Both A and B D. It does not show SN reactions

Q.19 If an nucleophile is the attacking reagent which one would be the most reactive one
A. R – F B. R – Cl
C. R – Br [✓ D. R – I]

Q.20 During S_N2 mechanism of alkyl halides C – X bond undergoes
A. Homolytic cleavage
[✓ B. Heterolytic cleavage]
C. Sometimes homolytic, sometimes heterolytic
D. C–X bond is not cleaved in S_N2 reactions

Q.21 Which of the following is true about R – I
A. They are most reactive alkyl halide for a given alkyl group
B. They show maximum boiling point for a given alkyl group
C. Cannot be prepared directly by reaction of alkanes with I_2
[✓ D. All are true]

Q.22 Which of the following reactions is not shown by R – X
A. Substitution reactions
B. Elimination reactions
C. Reduction
[✓ D. It shows all of above mentioned reactions]

Q.23 Most common reactions shown by alkyl halides are
[✓ A. Substitution] B. Elimination
C. Reduction D. Polymerization

Q.24 2° alkyl halides show both SN_1 and SN_2 reactions depending upon
A. Nature of functional group B. Temperature
[✓ C. Nature of solvent] D. All of these

Q.25 Ammonia reacts with excess of alkyl halide to form
A. 1°- amine B. 2°-amine
C. 3°-amine [✓ D. Mixture of 1°, 2° and 3° amines]

Q.26 The main factor which decides the reactivity of (R – X) is
[✓ A. C°–X bond strength] B. C – X bond polarity
C. Both C – X bond strength and polarity D. Boiling point of the given R– X

Q.27 Higher polarizable nucleophiles favour
[✓ A. Substitution reactions]
B. Elimination reactions
C. Favour both substitution and elimination reactions equally
D. Cannot be predicted

Q.28 $CH_3-Cl \xrightarrow[KOH]{Alc.} A$. **"A" product is**

A. CH_3-OH

B. CH_3-O-CH_3

C. CH_4

[✓ D. No reaction will occur]

Q.29 **Which among CH_3X, $R-CH_2-X$, R_2CHX, R_3CX is most reactive towards SN2 reaction**

A. R_3CX

B. RCH_2X

C. R_2CHX

[✓ D. CH_3X]

Q.30 **Consider the following haloalkanes**

1. CH_3F 2. CH_3Br

3. CH_3Cl 4. CH_3I

The increasing order of reactivity in SN reactions is

A. $4 < 3 < 2 < 1$

[✓ B. $1 < 3 < 2 < 4$]

C. $1 < 2 < 3 < 4$

D. $1 < 2 < 4 < 3$

Q.31 **The organic chloro compound which shows complete stereo chemical inversion during S_N2 reaction is**

A. $(C_2H_5)_2CHCl$

B. $(CH_3)_3CCl$

C. $(CH_3)_2CHCl$

[✓ D. CH_3-Cl]

Q.32 **Second step of which of the following pair of reaction is same**

A. E_1 + SN1

B. E_2 + SN1

C. SN1 + SN2

[✓ D. None of these]

Q.33 **Which of the following is the most stable carbocation**

A. Secondary

B. Primary

[✓ C. Tertiary]

D. All have same stability

Q.34 **Which reagent is a good nucleophile?**

[✓ A. NH_3]

B. HBr

C. Br_2

D. BH_3

Q.35 $CH_3-CH_2-OH+Alc.NH_3 \longrightarrow$

[✓ A. $CH_3CH_2-NH_2$]

B. CH_3-CH_2-H

C. CH_2-CH_2

D. $CH_3-CH_2-CH_3$

Q.36 **Which C–X bond has highest bond energy per mole**

A. C–Br

[✓ B. C–F]

C. C–Cl

D. C–I

Q.37 **Rate of E_1 reaction depends upon**

A. Concentration of nucleophile

B. Concentration of substrate as well as alkyl halide

[✓ C. Concentration of substrate only]

D. None of these

Q.38 **An alkyl halide may be converted to alcohol by**

A. Addition

B. Addition

[✓ C. Substitution]

D. Elimination

Q.39 **Neutral nucleophile among the following is**

A. CN^-

[✓ B. $:NH_3$]

C. Cl^-

D. $C_2H_5O^-$

Q.40 $CH_3CH_2-Br+CN^- \longrightarrow ?$

A. CH_3CH_2-Br

B. $CH_2=CH_2$

[✓ C. CH_3CH_2-CN]

D. No reaction take place

PAST PAPER QUESTIONS

MDCAT (2010)

Q.1 During S_N2 reaction, configuration of alkyl halide molecule is:

A. Remains same
B. Depends upon carbon atom
[✓ C. Gets inverted]
D. Depends upon electronegativity of halide

Q.2 When purely alcoholic solution of sodium/potassium hydroxide and halogen alkane are refluxed an alkene is formed:
CH_3-CH_2-Br (in presence of alcoholic KOH)→ CH_2=CH_2

MDCAT (2011)

What is the mechanism of the reaction

[✓ A. Elimination]
B. Dehydration
C. Debromination
D. Nucleophilic substitution

Q.3 The alkaline hydrolysis of bromoethane shown below gives alcohol as the product

$$CH_3-CH_2-Br \longrightarrow CH_2CH_2OH$$

MDCAT (2012)

The reagent and the condition used in this reaction may be

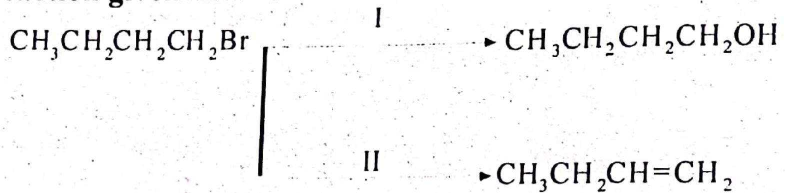
A. H_2O at room temperature
B. KOH is alcohol
C. Ethanol, heat
[✓ D. Dilute $NaOH_{(aq)}$, warm]

MDCAT (2012)

Q.4 In substitution reaction, secondary halogenoalkane give/show

A. S_N1 mechanism
B. Both E_1 and E_2
C. S_N2 mechanism
[✓ D. Both S_N1 and S_N2]

Q.5 Consider the reaction given below:



which statement is true?

MDCAT (2013)

A. Reagent for I is KOH in alcohol
B. Reagent for II is KOH in aqueous medium
[✓ C. Reaction II is elimination]
D. Reaction I is debromination

Q.6 If halogenalkanes are mixed with an excess of ethanoic ammonia and heated under pressure amine are formed. Which amine is formed in the following reaction?

$$CH_3CH_2Br + NH_3 \longrightarrow \text{Amine}$$

MDCAT (2014)

A. CH_3—CH_2—NH—CH_2—CH_3
B. CH_3—CH_2—CH_2—NH_2
[✓ C. CH_3—CH_2—NH_2]
D. H_2N—CH_2—CH_2—NH_2

Q.7 Consider the reaction given below:

$$CH_3-CH_2Br \xrightarrow[alcohol]{KOH} H_2C=CH_2+HBr$$

Mechanism followed by the reaction is:

MDCAT (2016)

[✓ A. E2]
B. S_N1
C. E1
D. S_N2

Q.8 During the S_N1 reaction, the fast reaction involves

MDCAT (2017)

A. Breakage of covalent bond
B. Transition state
C. Formation of carbocation
[✓ D. Attack of nucleophile]

Q.9 In elimination reaction, alcoholic KOH is used. OH^- in this case will act as

MDCAT (2017)

A. Electrophile
B. Leaving group
[✓ C. Base]
D. Acid

Q.10 **Which is an intermediate compound in S_N1:** MDCAT (2017)

A. Ethoxide ion B. Alkene

C. Alkyl halied [✓ D. Carbocation]

Q.11 **Among the alkyl halides, which always follows S_N2 mechanism:** MDCAT (2017)

[✓ A. Primary alkyl halides] B. Tertiary alkyl halide

C. Secondary alkyl halides D. Both A & C

Q.12 **In elimination reaction, __________ is used:** MDCAT (2017)

A. Acidic $K_2Cr_2O_7$ B. Acidic NaOH

C. $CuCl_2$ [✓ D. Alcoholic KOH]

Q.13 **Which halide ion has the capacity to act as both very good nucleophile and good leaving group in nucleophilic substitution reactions?** SET (2019)

[✓ A. I^-] B. Br^+

C. F^- D. Cl^-

Q.14 **Which one is not nucleophile?** NUMS (2019)

[✓ A. BF_3] B. NH_3

C. $-NH_2$ D. $-OR$

Q.15 **Which type of alkyl halides gives SN_2 mechanism?** NUMS (2019)

A. Secondary alkyl halides B. Tertiary alkyl halides

C. Vinyl halides [✓ D. Primary alkyl halides]

Q.16 **The compound which has the highest boiling point in the following is** ETEA (2019)

A. Methyl chloride [✓ B. Methyl iodide]

C. Methyl bromide D. Both a and b

Q.17 **Which product is obtained by the hydrolysis of 1–chlorobutane with the aqueous sodium hydroxide?** MDCAT (2019)

[✓ A. 1-butanol] B. 1-butanal

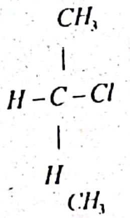
C. 1-butene D. Butanone

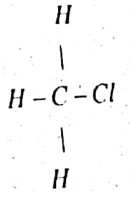
Q.18 **Alkyl halides involving –C-X bond breakage and –C-Nu bond formation simultaneously would follow the mechanism:** NMDCAT (2020)

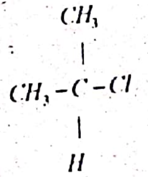
a. S_N1 [✓ B. S_N2]

c. E_1 D. E_2

Q.19 **Secondary alkyl halide is:** NMDCAT (2020)

A.

$$H-\overset{CH_3}{\underset{H}{C}}-Cl$$

B.

$$H-\overset{H}{\underset{H}{C}}-Cl$$

[✓ C.]

$$CH_3-\overset{CH_3}{\underset{H}{C}}-Cl$$

D. CH_3Cl

Q.20 **R-X on reaction with alcohols forms:** NMDCAT (20

A. R-OH [✓ B. ROR]

C. R-X OH D. RH

ANSWER KEY

1	A	11	D	21	D	31	D
2	B	12	C	22	D	32	D
3	D	13	B	23	A	33	C
4	B	14	D	24	C	34	A
5	C	15	A	25	D	35	A
6	B	16	B	26	A	36	B
7	A	17	D	27	A	37	C
8	D	18	A	28	D	38	C
9	B	19	D	29	D	39	B
10	A	20	B	30	B	40	C

PAST PAPER QUESTIONS

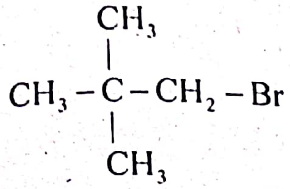
1	C	6	C	11	A	16	B
2	A	7	A	12	D	17	A
3	D	8	D	13	A	18	B
4	D	9	C	14	A	19	C
5	C	10	D	15	D	20	B

EXPLANATORY NOTES

Q.1 Alkyl halides are monohalo alkanes only $C_nH_{2n+1}X$

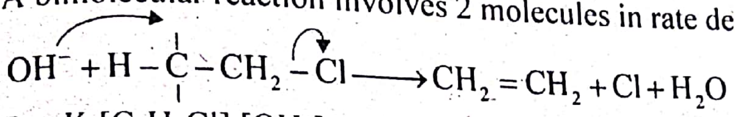
Q.2 Monohalo alkanes have only one halogen attached to hydrocarbon chain and follow general formula $C_nH_{2n+1}X$.

Q.3 Neo-pentyl bromide is a primary alkyl halide



$$CH_3-\overset{\overset{\large CH_3}{|}}{\underset{\underset{\large CH_3}{|}}{C}}-CH_2-Br$$

Q.4 A bimolecular reaction involves 2 molecules in rate determing step.



$$OH^- + H-\overset{|}{\underset{|}{C}}-CH_2-Cl \longrightarrow CH_2=CH_2+Cl+H_2O$$

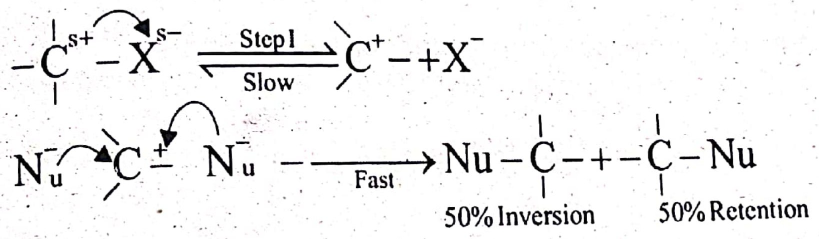
$R = K\,[C_2H_5Cl]\,[OH^-]$

Order = 1+1 = 2

Q.5 OH^- is very strong nucleophile and due to its high charge to size ratio it is strongly attached to carbon and hence a poor leaving group.

Q.6 Electrophilic α-carbon of alkyl group makes it a good substrate for nucleophile attach which is aided by good leaving groups.

Q.7



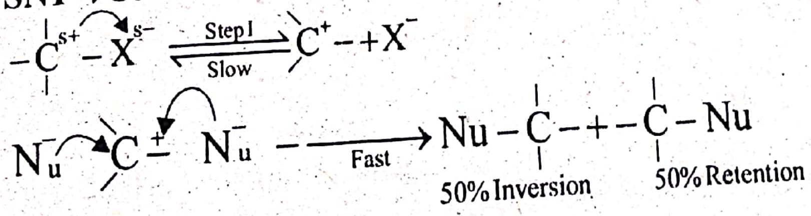
$$-\overset{|}{\underset{|}{C}}{}^{s+}-X^{s-} \underset{\text{Slow}}{\overset{\text{Step I}}{\rightleftharpoons}} \rangle C^+ - + X^-$$

$$N_u^- \;\; \rangle C^{+} \;\; N_u^- \xrightarrow[\text{Fast}]{} \underset{\text{50\% Inversion}}{Nu-\overset{|}{\underset{|}{C}}-} + \underset{\text{50\% Retention}}{-\overset{|}{\underset{|}{C}}-Nu}$$

$R = k[-\overset{|}{\underset{|}{C}}-X]$

Order = 1

Q.8 **SN1→Unimolecular nucleophilic substitution**



$$-\overset{|}{\underset{|}{C}}{}^{s+}-X^{s-} \underset{\text{Slow}}{\overset{\text{Step I}}{\rightleftharpoons}} \rangle C^+ - + X^-$$

$$N_u^- \;\; \rangle C^{+} \;\; N_u^- \xrightarrow[\text{Fast}]{} \underset{\text{50\% Inversion}}{Nu-\overset{|}{\underset{|}{C}}-} + \underset{\text{50\% Retention}}{-\overset{|}{\underset{|}{C}}-Nu}$$

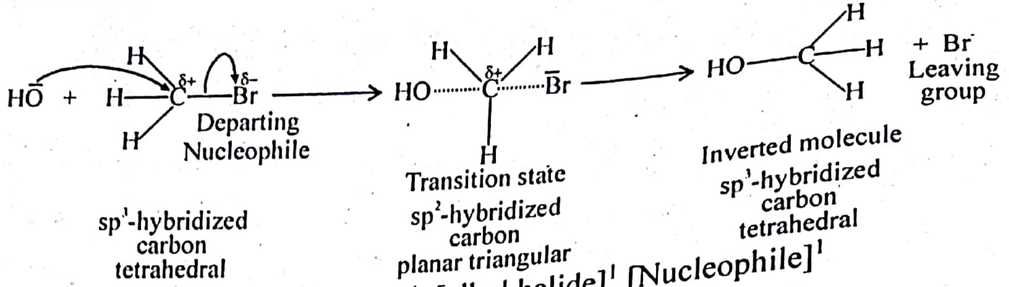
$R = k[-\overset{|}{\underset{|}{C}}-X]$

Order = 1

Q.9 β-Elimination involves attack of strong base (e.g. OH^-) on β-hydrogen.

Q.10 Tertiary alkyl halides can be ionized relatively easily due to stable carbocation hence giving S_N1 and E_1 mechanism in both first and the rate determing step involves ionization of $R-X$ to R^+.

Q.11



Rate = k [alkyl halide]^1 [Nucleophile]^1

Order = 1 + 1 = 2

Q.12

Reactivity of R−X → ∝ C−X bond polarity

→ ∝ C−X bond length

→ $\propto \frac{1}{\text{C−X bond energy}}$

→ $\propto \frac{1}{\text{Stability}}$

So greater stability means higher B.E

Q.13 SN reactions are favoured by a good leaving and stronger incoming group.

R → ∝ Strength of incoming Nu^-

→ $\propto \frac{1}{\text{Strength of leaving } Nu^-}$

Q.14 β-Elimination reaction produces alkenes from alcohol or alkyl halides.

$$R-CH_2-CH_2-X \xrightarrow{\text{Koltaic}} R-CH_2=CH_2+HX$$

$$R-CH_2-CH_2-OH \xrightarrow[180°C]{\text{conc.}H_2SO_4} R-CH_2=CH_2+H_2O$$

(Alkene)

Q.15 Reactivity through S_N2 mechanism

$$\propto \frac{1}{\text{Size of R}}$$

Hence the order

$CH_3X > C_2H_5-X > C_3H_7X$

Q.16 Thioalcohol = R − SH

$$R-Br+SH^- \longrightarrow R-SH+Br^-$$

Q.17 Greater steric hinderance, greater stability of R^+ and greater inductive effect favours S_N1.

Q.18 Ter. Butyl bromide is a tertiary alkyl halide, and tertiary alkyl halides favours S_N1.

Q.19 Reactivity of $R-X \propto \frac{1}{\text{C−X bond energy}}$

Reactivity order

$R-I > R-Br > R-Cl > R-R$

Q.20 In heterolytic cleavage one of the atoms leaves with both of the shared electrons in S_N2 mechanism leaving X^- gets both electron.

$$R\text{-}X + Nu^{-1} \longrightarrow R\text{-}Nu + X^{-1}$$

Q.21 (i) Due to low bond energy reactivity is highest.

(ii) Greater polarizability of "I" increases boiling point.

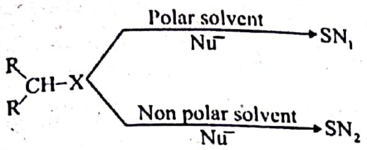
(iii) R − I are highly reactive and gives reversible reaction so cannot be prepared directly.

Q.22 $R-X$ shows $\rightarrow$ SN

$\rightarrow \beta-E$

$\rightarrow$ Reduction

Q.23 $R^{\delta+}X^{\delta-}$ are good substrate for nucleophile attack of α-carbon giving mostly SN reaction.

Q.24 

In polar solvent formation of carbocation is favoured which allows S_N1 mechanism.

Q.25 When $R-X$ is excess, these are enough $R-X$ molecules to react with NH_3 and make 1°, 2° and 3° amines.

Q.26 $C-X$ bond has to be broken in order to another Nu^- to replace X^-. So bond energy is major factor.

Q.27 Higher polarizable nucleophile gives off electron easily to electrophilic carbon favouring substitution while it does not favour elimination as it is weak base.

Q.28 KOH in alcoholic medium favour β-elimination, as CH_3-Cl lack β-hydrogen so no reaction may occur.

Q.29 Smaller the R group greater the reactivity. Reactivity order towards S_N2 $CH_3X > RCH_2X > R_2CHX > R_3CX$ increase in R – groups increases steric hindrance.

Q.30 Reactivity of $R-X \propto \dfrac{1}{\text{B.E of } C-X}$

Bond energy order

$C-F > C-Cl > C-Br > C-I$

Hence reactivity order

$CH_3F < CH_3Cl < CH_3Br < CH_3I$

Q.31 CH_3Cl gives only S_N2 reaction giving complete inversion.

Q.32 First step is same in S_N1 and E_2 i.e. ionization to form carbocation. While 2nd step is different in all S_N1, S_N2, E_1 and E_2.

Q.33 Order of stability of carbocations

Tertiary > Secondary > Primary

Stability of $R^+ \propto$ Number of β-hydrogens $\propto$ Inductive effect

Q.34 NH_3 has a lone pair to donate which makes it a good nucleophile..

Q.35 $CH_3-CH_2-Br + Alc.NH_3 \xrightarrow{S_N2} CH_3CH_2-NH_2 + HBr$

Q.36 Bond energy $\propto \dfrac{1}{B.L} \propto \Delta E.N$

Order of B.E $C-F > C-Cl > C-Br > C-I$

Q.37 For E_1 reaction $R = K[R-X]$ unimolecular mechanism.

Q.38 $R-X + OH^-_{(aq)} \xrightarrow{SN} R-OH + X^-$

X^- is substituted by OH^-

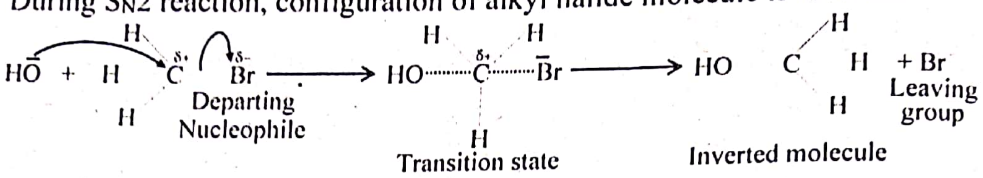
Q.39 NH_3 has no net charge. It is nucleophile due to presence of lone pair on nitrogen atom

Q.40 $CH_3-CH_2-Br + CN^- \xrightarrow{S_N2} CH_3-CH_2-CN + Br^-$

EXPLANATORY NOTES

(PAST PAPER QUESTIONS)

Q.1 During S_N2 reaction, configuration of alkyl halide molecule is inverted



Q.2 Production of alkenes by alkyl halides in the presence of alcohlic KOH is due to elimination mechanism.

Q.3 Alkyl halides produce alcohols under SN mechanism using aqueous solution of NaOH or KOH (slightly warmed).

Q.4 Secondary alkyl halides undergo both S_N1 and S_N2.

Q.5 Reaction I is SN reaction using aqueous KOH while reaction II is elimination using alcoholic KOH.

Q.6 Ethyl bromide gives primary amine with excess of ammonia. If R-X is in excess the mixture of primary, secondary, tertiary and quaternary amine is obtained.

Q.7 Preparation of alkene indicates the elimination mechanism while presence of primary alkyl halides indicates the E_2 mechanism.

Q.8 S_N1 mechanism is consisted of two step, 1st step is formation of carbocation which is slow while 2nd step is attack of nucleophile which is fast.

Q.9 In the elimination reaction, OH^{-1} act as a base which attacks on β-hydrogen

Q.10 Intermediate species formed during S_N1 mechanism is carbocation.

Q.11 During nucleophillic substitution reactions, primary alkyl halides always follow the S_N1 mechanism.

Q.12 In elimination reactions alcohlic KOH is used.

Q.13 Iodide ion (I^{-1}) behaves as a good leaving group as well as good nucleophile due to its larger size and high polarizibility.

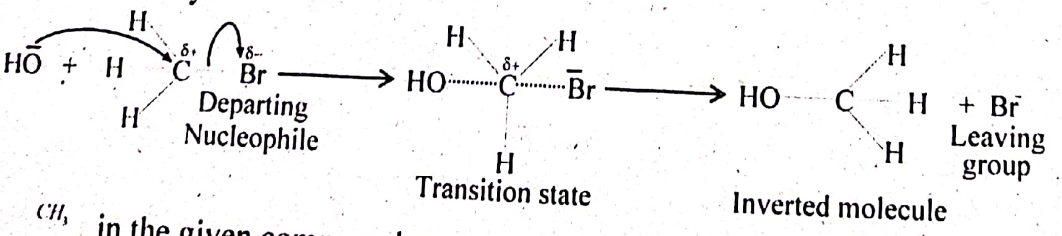
Q.14 BF_3 is an electrophile while all other are nucleophiles.

Q.15 During nucleophilic substitution reactions, primary alkyl halides always follow the S_N1 mechanism.

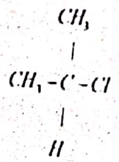
Q.16 Methyl iodide has highest boiling point due to larger size and high polarizibility of iodine.

Q.17 1–chlorobutane with the aqueous sodium hydroxide gives 1-butanol.

Q.18 During S_N2 mechanism, C-X bond breaking and C – Nu bond formation occurs simultaneously.



Q.19



$$CH_3-\overset{CH_3}{\underset{H}{C}}-Cl$$

in the given compound, α-carbon contains 2 "R" groups so its secondary R-X.

Q.20 Alkyl halides and alcohols react to form ethers.

Topic 16

ALCOHOLS AND PHENOLS

PRACTICE EXERCISE

Q.1 Which of the following can be used for alcohol denaturing

A. Methanol
B. Acetone
C. Pyridine
[✓ D. All of these]

Q.2 Absolute alcohol is

[✓ A. 100% C_2H_5OH]
B. 100% CH_3OH
C. 95% C_2H_5OH
D.15% C_2H_5OH

Q.3 The carbon to which functional group in alcohols is attached is

[✓ A. ∝-Carbon]
B. β-Carbon
C. Saturated carbon
D. Both A and C

Q.4 Alcohol in which hydroxyl is attached to carbon which is further attached to two alkyl groups is

A. Primary alcohol
B. Tertiary alcohol
[✓ C. Secondary alcohol]
D. None of these

Q.5 Isobutyl alcohol and isopentyl alcohol are

[✓ A. Primary alcohols]
B. Tertiary alcohol
C. Secondary alcohols
D. All

Q.6 Identify a tertiary alcohol

A. 2–Pentanol
[✓ B. 2 – Methyl – 2 – butanol]
C. 2,2–Dimethyl –1 – propanol
D. 3– Methyl – 2– butanol

Q.7 Dehydration of alcohols with conc. H_2SO_4 at 180°C gives:

A. Ethers
B. Esters
[✓ C. Alkenes]
D. Alkyl halides

Q.8 Among alkenes which one produces t°-butyl alcohol on acid hydration

[✓ A. $(CH_3)_2 - C = CH_2$]
B. $CH_3 - CH = CH - CH_3$
C. $CH_3 - CH_2 - CH = CH_2$
D. $CH_3 - CH = CH_2$

Q.9 During hydration of alkenes to form alcohols, alkenes are first dissolved in

A. Water
[✓ B. Concentration H_2SO_4]
C. Dilute H_2SO_4
D. Both B and C can be used

Q.10 Primary alcohols upon oxidation with acidified dichromate gives:

[✓ A. Aldehydes]
B. Ketones
C. Branched alkenes
D. All of these

Q.11 Tertiary alcohols with acidified dichromate gives:

A. Aldehydes
B. Ketones
[✓ C. Alkenes]
D. Alkynes

Q.12 Which of the following reacts with aqueous alkaline iodine:

A. 1-Propanol
[✓ B. Ethanol]
C. Methanol
D. 2-Methyl-2-propanol

Q.13 When alcohols react with Na metal, the alkoxide ion thus formed is a strong

A. Electrophile
[✓ B. Nucleophile]
C. Acid
D. Free radical

Q.14 An organic compound X is prepared by the oxidation of ethanol. This X reacts with ethanol to produce an ester, what is X likely to be:

A. Methanoic acid
[✓ B. Ethanoic acid]
C. Propanoic acid
D. Butanoic acid

Q.15 Which inorganic reagent may be used to distinguish between phenol and methanol
A. Alkaline aqueous I_2
[✓ B. $K_2Cr_2O_7$ in dil. H_2SO_4]
C. Aqueous $NaHCO_3$
D. Na metal

Q.16 $K_2Cr_2O_7/H_2SO_4$ generates
A. O_2
B. H_2
[✓ C. [O]]
D. [H]

Q.17 Esterification takes place when an alcohol reacts with
[✓ A. Organic acid]
B. Inorganic acid
C. Both organic and inorganic acids
D. Ethers

Q.18 During preparation of ester, the bridge oxygen is from
[✓ A. Alcohol]
B. Acid
C. Ether alcohol or acid
D. Catalyst

Q.19 Which of the following is incorrect
A. 1° alcohol oxidizes to form aldehyde which is further oxidized to carboxylic acid
B. 2° alcohol oxidizes to form ketone, which is further oxidized to carboxylic acid
C. 3° alcohol is not oxidized in presence of $K_2Cr_2O_7/H_2SO_4$
[✓ D. All are correct statements]

Q.20 Alcohols react with Na metal to produce
A. R–ONa
[✓ B. Both A and B]
C. H_2 gas
D. No reaction takes place

Q.21 When an alcohol reacts with PX_5, the order or reactivity of alcohol is
A. $1° > 2° > 3°$
[✓ B. $3° > 2° > 1°$]
C. $1° > 2° > 3°$
D. Both B and C are correct

Q.22 There are four alcohols P, Q, R and S with 3,2,1 and zero $\propto$-hydrogens which will not respond to $Na_2Cr_2O_7/H_2SO_4$
A. P
B. Q
C. R
[✓ D. S]

Q.23 Alkanol + [o] $\xrightarrow{K_2Cr_2O_7+H_2SO_4}$ A $\xrightarrow{''}$ B
The correct products are
[✓ A. $A = C_nH_{2n}O$, $B = C_nH_{2n}O_2$]
B. $A = C_nH_{2n+2}O$, $B = C_nH_{2n}O_2$
C. $A = C_nH_{2n}O_2$, $B = C_nH_{2n}O$
D. $A = C_nH_{2n}O$, $B = C_nH_{2n+2}O$

Q.24 When ethanol reacts with sodium metal than
A. C—O bond breaks
B. C—C bond breaks
[✓ C. O—H bond breaks]
D. C—H bond breaks

Q.25 The number of moles of diol are required to produce one mole of hydrogen gas.
[✓ A. 1]
B. 3
C. 2
D. 4

Q.26 Rasberry flavoured compound is produced by a condensation process. The process may be
A. Addition
B. Evaporation
C. Elimination
[✓ D. Esterification]

Q.27 **The one of the functional group isomer of alkoxy alkane reacts with alkanoic acid to produce**
[✓ A. Alkyl alkanoate]
B. Alkane alkanoic acid
C. Alkoxy alkanoate
D. Alkyl alkoxy alkane

Q.28 **In esterification reaction, which one of the following bonds of alcohol undergo cleavage**
A. C — H
B. C — O
[✓ C. O — H]
D. C — C

Q.29 **Excess alcohol at low temperature in presence of conc. of H_2SO_4 produce**
[✓ A. Ether]
B. Organic acid
C. Ester
D. Alkene

Q.30 **Phenol reacts with aqueous bromine and decolorizes aqueous bromine forming the white precipitates of:**
A. 2, 4-Dibromophenol
B. 2-Bromophenol
[✓ C. 2, 4, 6-Tribromophenol]
D. 3-Bromophenol

Q.31 **Picric acid can be prepared from phenol by**
A. Halogenation
[✓ B. Nitration]
C. Oxidation
D. Sulphonation

Q.32 **Which one can be used as test for phenol**
A. $C_6H_5OH + CH_3COCl$ in the presence of aq. NaOH
B. $C_6H_5OH + HCHO$ in the presence of NaOH
C. $C_6H_5\bar{O}Na^+ + CH_3CH_2Br$
[✓ D. $C_6H_5OH + Br_2$ (excess)]

Q.33 **Phenol on treatment with dil. HNO_3 at low temperature give**
A. o-Nitrophenol
B. m-Nitrophenol
C. p-Nitrophenol
[✓ D. Mixture of o-Nitrophenol]

Q.34 **Phenol can be distinguished from alcohol by**
A. Tollen's reagent
[✓ B. $Br_{2(aq)}$]
C. $NaHCO_3$
D. HCl

Q.35 **The reaction of carbolic acid with caustic soda is used to produce colorless product. The molecular formula of the product is**
A. C_6H_6ONa
B. C_7H_6O
C. C_6H_4OH
[✓ D. C_6H_5ONa]

Q.36 **Phenol and ethanol can be distinguish by all except**
A. Iodoform test
[✓ B. Na–metal]
C. Aq. Br_2
D. Lucas-reagent

Q.37 **The reaction of phenol in which ring is involved except**
A. Nitration
[✓ B. Esterification]
C. Sulphonation
D. Bromination

Q.38 **What is correct order for acidity of water, phenol and ethanol**
[✓ A. $C_6H_5OH > H_2O > C_2H_5OH$]
B. $H_2O > C_2H_5OH > C_6H_5OH$
C. $C_6H_5OH > C_2H_5OH > H_2O$
D. $H_2O > C_6H_5OH > C_2H_5OH$

Q.39 **Conjugation between unshared electron pair on oxygen and aromatic ring in phenoxide ion results in**
A. Shorter C – O bond distance
B. Stable base
C. Stronger acidic character
[✓ D. All of these]

Q.40 **The alcohol more acidic in nature is**
[✓ A. Methanol]
B. Propanol
C. Ethanol
D. Butanol

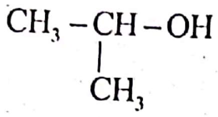
PAST PAPER QUESTIONS

Q.1 Dissociation constant of phenol is: **MDCAT (2010)**

A. 1.2×10^{-10}
B. 1.2×10^{10}
C. 1.3×10^{10}
[✓ D.] 1.3×10^{-10}

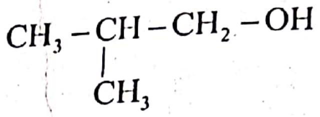
Q.2 Which of the following is secondary alcohol? **MDCAT (2011)**

[✓ A.]



$CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-OH$

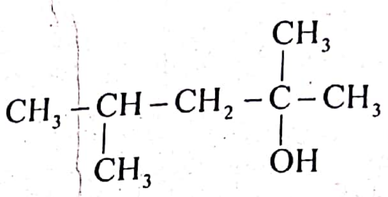
B.



$CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2-OH$

C. $CH_3-CH_2-CH_2-OH$

D.

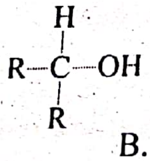


$CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2-\overset{\displaystyle CH_3}{\overset{|}{\underset{\displaystyle OH}{\underset{|}{C}}}}-CH_3$

Q.3 An alcohol is converted into an aldehyde with same number of carbon atoms in the presence of K_2CrO_4/H_2SO_4. the alcohol is **MDCAT (2011)**

A. $CH_2C(CH)_2OH$
[✓ B.] $CH_3CH_2CH_2OH$
C. $(CH_3)_3COH$
D. $(CH_3)_2CHOH$

Q.4 The following structure is of: **MDCAT (2012)**



$R-\overset{\displaystyle H}{\overset{|}{\underset{\displaystyle R}{\underset{|}{C}}}}-OH$

[✓ A.] Secondary alcohol
B. Tertiary alcohol
C. Primary alcohol
D. Carboxylic acid

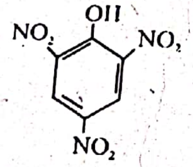
Q.5 Consider the following reaction

$C_2H_5OH + PCl_5 \rightarrow ?$

What product (s) may be formed? **MDCAT (2013)**

[✓ A.] C_2H_5Cl, $POCl_3$ and HCl
B. C_2H_5Cl and HCl
C. C_2H_5Cl only
D. C_2H_5Cl and $POCl_3$

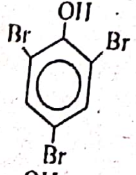
Q.6 ____________________ is named as **MDCAT (2013,2016)**



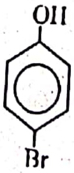
A. Nitro phenol
B. Malonic acid
C. Benzoic acid
[✓ D.] Picric acid

Q.7 Aqueous phenol decolorizes bromine water to form a white precipitate. What is the structure of the white precipitate formed? **MDCAT (2013)**

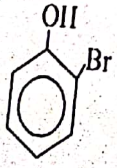
[✓ A.]



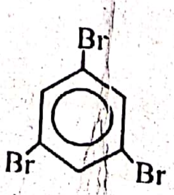
B.



C.



D.



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Q.8 **Primary, secondary and tertiary alcohols can be identified and distinguished by** MDCAT (2014)

●. Lucas test
B. Bayer's test
C. Iodoform test
D. Silver mirror test

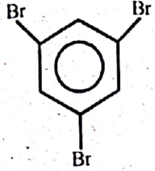
Q.9 **Which one of the following groups is indicated when HCl is formed by reaction of ethanol with phosphorus pentachloride?** MDCAT (2014)

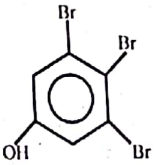
A. Amino group
B. Halide group
●. Hydroxyl group
D. Hydride group

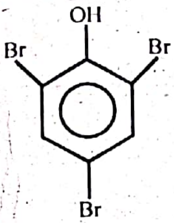
Q.10 **Which one of the following alcohol is indicated by formation of yellow crystals in iodoform tests?** MDCAT (2014)

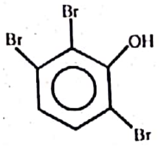
A. Methanol
B. Butanol
●. Ethanol
D. Proponal

Q.11 **The formula of 2, 4, 6-Tribromophenol is** MDCAT (2014,2016)

A.


B.


●.


D.


Q.12 **How will you distinguish between methanol and ethanol?** MDCAT (2015)

A. By lucas test
B. By oxidation
C. By silver mirror test
●. By iodoform test

Q.13 **Which one of the following is an appropriate indication of positive iodoform test?** MDCAT (2016)

A. Formation of H_2O
B. Brick red precipitate
C. Release of H_2 gas
●. Yellow crystal

Q.14 **$(CH_3)_3C-OH$ Which one of the following is proper classification of the above formula?** MDCAT (2016)

A. Primary
●. Tertiary
C. Secondary
D. Polyhydric

Q.15 **$C_2H_5-SO_4H \xrightarrow[\text{Warm}]{H_2O} C_2H_5-OH+H_2SO_4$ choose the correct type for this reaction from the following?** MDCAT (2017)

A. Reduction
B. Hydroxylation
C. Oxidation
●. Hydration

Q.16 **$CH_3-CH_2-OH+PCl_5 \longrightarrow CH_3-CH_2Cl+POCl_3+HCl$ formation of HCl is test for the presence of ___ in a compound** MDCAT (2017)

A. Alkyl group.
B. Saturated alkyl group
●. Hydroxyl group
D. Acid H^+ ion

Q.17 **$C_2H_5OH+CH_3-COOH \xrightleftharpoons{H_2SO_4}$? what will be the exact product** MDCAT (2017)

A. Diethyl ether
●. Ethyl acetate
C. Methyl propyl ether
D. Butyl alcohol

Q.18 **At $25^{0}C$ with phenol 2-4 Dinitrophenol is formed by the reaction of:** MDCAT (2017)

A. $(HNO_3+H_2SO_4)$ with benzene
B. NaOH with Benzene sulphonic acid
●. $(HNO_3+H_2SO_4)$ with phenol
D. Sodium phenoxide with HCl

Q.19 The phenoxide ion is more stable than ethoxide ion as **MDCAT (2017)**

[✓ A]. Lone pair on O-atom overlaps with the delocalized π-bonding system in benzene.
B. Oxygen atom is directly bonded with benzene ring in phenoxide ion
C. The negative charge is localized on oxygen atom of phenoxide ion
D. The negative charge is delocalized on oxygen atom of ethoxide ion

Q.20 The acidity of phenol is due to its________: **MDCAT (2017)**

A. Nature of Benzene
[✓ B]. Nature of phenoxide
C. Double bond in benzene ring
D. Hydroxyl group

Q.21 Alcohol in which carbon atom bonded to –OH group is further attached with three alkyl group is **MDCAT (2018)**

A. Aromatic alcohol
B. Primary alcohol
C. Secondary alcohol
[✓ D]. Tertiary alcohol

Q.22 Which one the following compounds is known as tertiary alcohol? **MDCAT (2018)**

A. 2-Methyl-1-propanol
[✓ B]. 2-Methyl-2-propanol
C. 2-Propanol
D. 1-Propanol

Q.23 Ethanol, ethanoic acid and phenol all contain acidic functional groups, the order of the acidic strength is Ethanoic acid> phenol>ethanol **SET (2019)**

This is mainly due to

A. Electron releasing (donating) effect of ethanoic acid is greater than that of ethanol
B. Electron releasing (donating) effect of phenol is greater than that of ethanol
C. Electron with drawing effect of phenol is greater than that of ethanol
[✓ D]. Electron with drawing effect of ethanoic acid is greater than that of phenol

Q.24 Distinction between ethanol and phenol can be ascertained by **SET (2019)**

A. Lucas test
B. Tollen's test
C. Iodoform test
[✓ D]. Reaction with bromine

Q.25 Choose a primary alcohol among the following **SET (2019)**

A. 2-methyl-2-propanol
[✓ B]. 2,2-dimethyl-1-propanol
C. 2-propanol
D. 3-methyl-2butanol

Q.26 Dehydration of ethanol at 180°C in the presence of conc-H_2SO_4 gives **NUMS (2019)**

[✓ A]. Ethene
B. Ethane
C. Ethyne
D. Ether

Q.27 Industrially water gas is converted into methanol by using catalyst **NUMS (2019)**

A. $CuO + ZnO$
B. $CuO + Cr_2O_3$
C. $Al_2O_3 + ZnO$
[✓ D]. $ZnO + Cr_2O_3$

Q.28 Phenol react with CH_3COCl to give **NUMS (2019)**

A. Acid
[✓ B]. Ester
C. Aldehyde
D. Ketone

Q.29 Choose reaction that does not require $ZnCl_2$ Catalyst: **ETEA (2016)**

A. $CH_3CH_2OH + HCl \longrightarrow CH_3CH_2Cl + H_2O$
B. $CH_3CH_2OH + HBr \longrightarrow CH_3CH_2Br + H_2O$
C. $CH_3CH_2OH + HI \longrightarrow CH_3CH_2I + H_2O$
[✓ D]. Both B & C

Q.30 Tertiary alcohols are not oxidized into carbon compounds because **ETEA (2019)**

A. They contain more alkyl group
[✓ B]. They have no alpha-hydrogen
C. Suitable oxidizing agent is not available
D. None of the above

Q.31 Ketones can be made by oxidation of MDCAT (2019)

A. Primary Alcohols
[✓ B. Secondary Alcohols]
C. Tertiary Alcohols
D. Aldehydes

Q.32 Select the reagent X from the following choices for this conversation; MDCAT (2019)

$$CH_3CH(OH)CH(CH_3)_2 \xrightarrow{\text{Reagent X}} CH_3COCH(CH_3)_2$$

A. Acidified Phosphoric acid
[✓ B. Acidified Potassium dichromate (VI)]
C. Acidified Potassium hydroxide
D. Acidified Oxalic acid

Q.33 IUPAC name of $C_6H_5O(CH_3)_2$ is NMDCAT (2020)

A. 2-Methyl-3-hexanone
[✓ B. 2,6-Dimethyl cyclohexanone]
C. 3-Methyl cyclohexanone
D. 4-Methy l-3-hexanone

(NOTE: this is the original NMDCAT question, its correct formula must be $C_6H_8O(CH_3)_2$ then B option will be right)

Q.34 Phenol is known as: NMDCAT (2020)

A. Carpolic acid
B. Carbonylic acid
[✓ C. Carbolic acid]
D. Carbolylic acid

Q.35 Phenol is more acidic than alcohols because of the following reason NMDCAT (2020)

A. Delocalization of negative charge in the OH group
B. Delocalization of positive charge on the carbon atom in ring
[✓ C. Delocalization of negative charge in the ring]
D. Delocalization of positive charge in the OH group

ANSWER KEY

1	D	11	C	21	B	31	B
2	A	12	B	22	D	32	D
3	A	13	B	23	A	33	D
4	C	14	B	24	C	34	B
5	A	15	B	25	A	35	D
6	B	16	C	26	D	36	B
7	C	17	A	27	A	37	B
8	A	18	A	28	C	38	A
9	B	19	D	29	A	39	D
10	A	20	B	30	C	40	A

PAST PAPER QUESTIONS

1	D	6	D	11	C	16	C	21	D	26	A	31	B
2	A	7	A	12	D	17	B	22	B	27	D	32	B
3	B	8	A	13	D	18	C	23	D	28	B	33	B
4	A	9	C	14	B	19	A	24	D	29	D	34	C
5	A	10	C	15	D	20	B	25	B	30	B	35	C

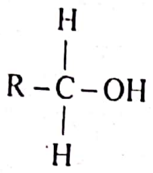
EXPLANATORY NOTES

Q.1 Denatured alcohol is poisonous to user. Methanol, acetone and pyridine all can be added to make it poisonous.

Q.2 Absolute alcohol is pure ethanol i.e. 100% ethanol.

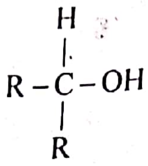
Q.3 $-\overset{\gamma}{C}-\overset{\beta}{C}-\overset{\alpha}{C}-F.G$

Q.4



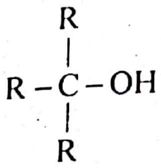
$$R-\overset{\overset{H}{|}}{\underset{\underset{H}{|}}{C}}-OH$$

Primary alcohol



$$R-\overset{\overset{H}{|}}{\underset{\underset{R}{|}}{C}}-OH$$

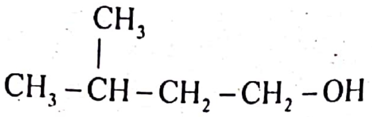
Secondary alcohol



$$R-\overset{\overset{R}{|}}{\underset{\underset{R}{|}}{C}}-OH$$

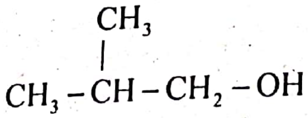
Tertiary alcohol

Q.5



$$CH_3-\overset{\overset{CH_3}{|}}{CH}-CH_2-CH_2-OH$$

Iso-pentyl alcohol

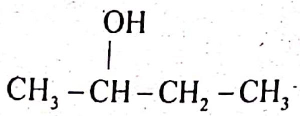


$$CH_3-\overset{\overset{CH_3}{|}}{CH}-CH_2-OH$$

Iso-butyl alcohol

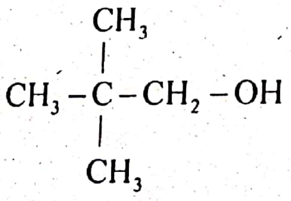
in both –OH is attached to primary carbon.

Q.6



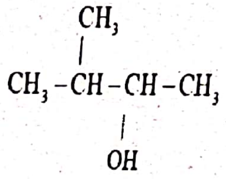
$$CH_3-\overset{\overset{OH}{|}}{CH}-CH_2-CH_3$$

2-Pentanol (1° ROH)



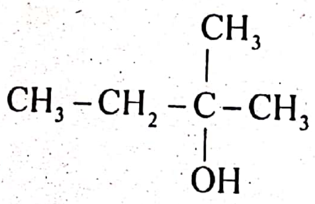
$$CH_3-\overset{\overset{CH_3}{|}}{\underset{\underset{CH_3}{|}}{C}}-CH_2-OH$$

2,2-Dimethyl-1-propanol (1° ROH)



$$CH_3-\overset{\overset{CH_3}{|}}{CH}-\underset{\underset{OH}{|}}{CH}-CH_3$$

3-Methyl-2-Butanol (2° ROH)



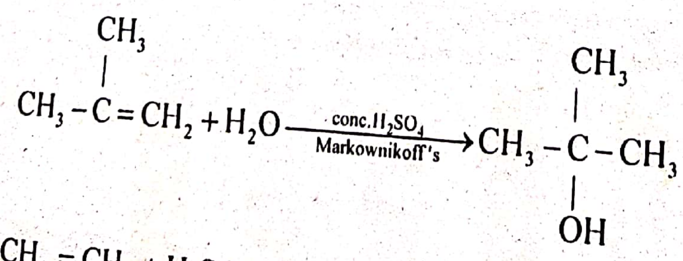
$$CH_3-CH_2-\overset{\overset{CH_3}{|}}{\underset{\underset{OH}{|}}{C}}-CH_3$$

2-Methyl-2-Butanol (3° ROH)

Q.7 $CH_3-CH_2-OH\xrightleftharpoons[180^\circ]{\text{conc.}H_2SO_4}CH_2=CH_2+H_2O$

At high temperature β-elimination is promoted.

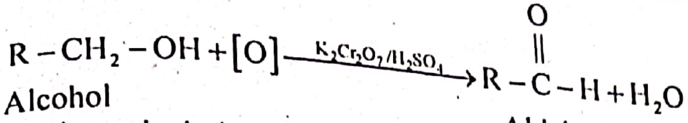
Q.8



$$CH_3-\overset{\overset{CH_3}{|}}{C}=CH_2+H_2O\xrightarrow[\text{Markownikoff's}]{\text{conc.}H_2SO_4}CH_3-\overset{\overset{CH_3}{|}}{\underset{\underset{OH}{|}}{C}}-CH_3$$

Q.9 $CH_2=CH_2+H_2SO_4\rightleftharpoons CH_3-CH_2-SO_4H\xrightleftharpoons{H_2O(100^\circ c)}CH_3-CH_2-OH+H_2SO_4$

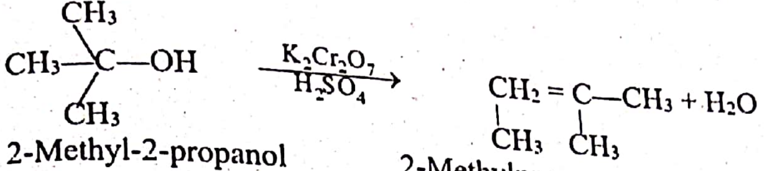
Q.10



$$R-CH_2-OH+[O]\xrightarrow{K_2Cr_2O_7/H_2SO_4}R-\overset{\overset{O}{\|}}{C}-H+H_2O$$

Alcohol Aldehyde

Q.11 Tertiary alcohol do not undergo oxidation instead they undergo β-elimination to give alkenes.

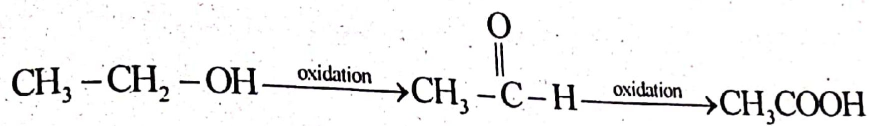


2-Methyl-2-propanol 2-Methylpropene

Q.12 Ethanol is the only primary alcohol to give iodoform test.

Q.13 R–O⁻ is an electron efficient specie hence a strong nucleophile.

Q.14



$$CH_3-CH_2-OH\xrightarrow{\text{oxidation}}CH_3-\overset{\overset{O}{\|}}{C}-H\xrightarrow{\text{oxidation}}CH_3COOH$$

Ethanol ethanoic acid

(X)

$$\underset{(X)}{CH_3COOH}+C_2H_5OH\xrightleftharpoons{H_2SO_4}\underset{\text{ester}}{CH_3-CO-OC_2H_5}+H_2O$$

$(X)=\text{Ethanoic acid}$

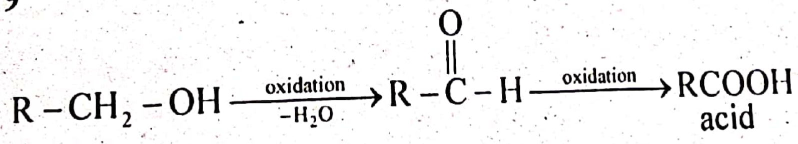
Q.15 Methanol gets oxidized by acidified $K_2Cr_2O_7$ but phenol does not.

Q.16 $K_2Cr_2O_7+4H_2SO_4\longrightarrow K_2SO_4+Cr(SO_4)_3+4H_2O+3[O]$ esterification.

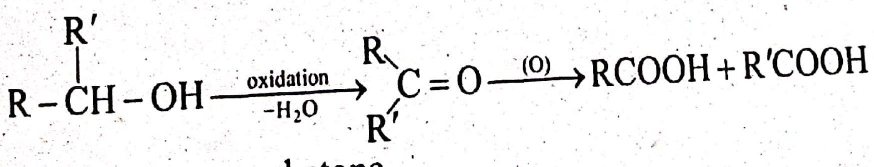
Q.17 $$\underset{\text{Organic acid}}{RCOOH}+\underset{\text{Alcohol}}{R'OH}\xrightleftharpoons{H_2SO_4}\underset{\text{Ester}}{RCOOR'}+H_2O$$

Q.18 –OH group of acid is replaced by RO⁻ of alcohol giving SN reaction. So, bridge oxygen comes from alcohol.

Q.19



$$R-CH_2-OH\xrightarrow[-H_2O]{\text{oxidation}}R-\overset{\overset{O}{\|}}{C}-H\xrightarrow{\text{oxidation}}\underset{\text{acid}}{RCOOH}$$



$$R-\overset{\overset{R'}{|}}{C}H-OH\xrightarrow[-H_2O]{\text{oxidation}}\underset{\text{ketone}}{\overset{R}{\underset{R'}{\diagdown}}C=O}\xrightarrow{(O)}RCOOH+R'COOH$$

Tertiary Alcohol are not oxidized

Q.20 $2ROH+2Na\longrightarrow 2R-ONa+H_2$

Q.21 Reaction of alcohol with PX_5 is nucleophilic substitution reaction in which OH⁻ replaced by X⁻ and C–O bond is broken hence the order 3° > 2° > 1°.

Q.22 Zero α-hydrogen means "S" is tertiary alcohol, hence it does not undergo oxidation.

Q.23 $\text{Alkanol} \xrightarrow{\text{oxidation}} \underset{\substack{A \\ C_nH_{2n}O}}{\text{Aldehyde}} \xrightarrow{\text{oxidation}} \underset{\substack{B \\ C_nH_{2n}O_2}}{\text{Carboxylic acid}}$

Q.24 $2C_2H_5OH + 2Na \longrightarrow C_2H_5ONa + H_2$

It is replaced by Na^+ by breaking O–H bond.

Q.25 $HO-CH_2-CH_2-OH \xrightarrow{2Na} NaO-CH_2-CH_2-ONa + H_2$

Diols have 2 replaceable hydrogen.

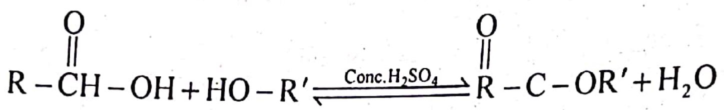
Q.26 Esters give off particular flavours.

Isobutyl formate = Raspberry flavour.

Iso-Butyl alcohol + Formic acid $\xrightleftharpoons{\text{Esterification}}$ Isobutyl formate.

Q.27 Functional group isomer of alkoxy alkanes (ethers) is alkanol (alcohol) which reacts with alkanoic acids (carboxylic acids) to give esters (alkoxy alkanoate).

Q.28

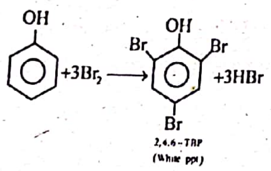


$$R-\overset{\overset{O}{\|}}{C}H-OH+HO-R' \xrightleftharpoons{Conc.H_2SO_4} R-\overset{\overset{O}{\|}}{C}-OR'+H_2O$$

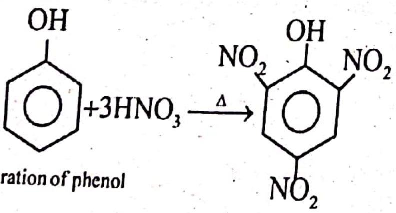
Reaction shows breakage of O–H bond in alcohol

Q.29 Low temperature favours formation of ethers by dehydration of alcohols, while high temperature favours β-elimination to form alkenes.

Q.30



Q.31 .

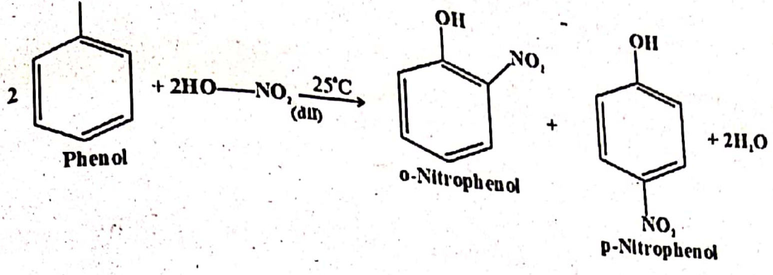


Nitration of phenol

Picric acid

Q.32 Phenol can be tested by bromine water test, as it gives white ppt of 2,4,6-Tribromophenol.

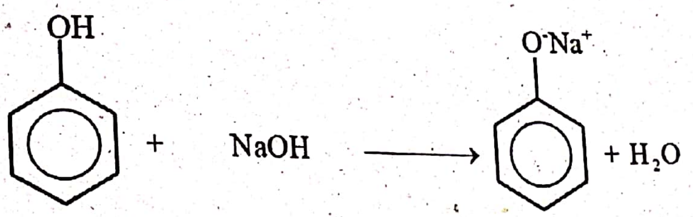
Q.33



Q.34 Both alcohols and phenol do not give Tollen's test, $NaHCO_3$ test and reaction with HCl. However, phenol reacts with Br_2, to give white ppt but alcohol does not.

Q.35

Phenol reacts with alkalis to form salts e-g;



Sodium Phenoxide

Q.36

Test	Phenol	Ethanol
Iodoform	✗	✓
Br_2 water	✓	✗
Na-Metal	✓	✓
Lucas-test	✗	✓

Hence, Na-metal cannot distinguish between phenol and ethanol.

Q.37 Esterification is due to OH group and not the ring.

Q.38 Phenol is more acidic due to resonance in phenoxide, then comes water and alcohol is least acidic due to unstable alkoxide ion.

Q.39 Conjugation between O^- and benzene ring gives C–O bond a double bond characters that leads to

i) Shorter bond length
ii) Resonance give stability to phenoxide
iii) Stability of conjugate base ∝ Acidic strength

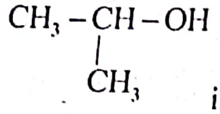
Q.40 Alcohol that gives stable alkoxide ion are more acidic stability order of $R\text{–}O^-$.

$$CH_3O^- > C_2H_5-O^- > C_3H_7O^- > C_4H_9O^-$$

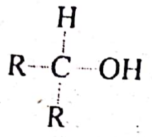
EXPLANATORY NOTES

(PAST PAPER QUESTIONS)

Q.1 Dissociation constant (Ka) of phenol is 1.3×10^{-10}

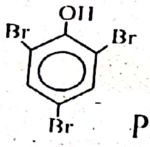
Q.2 
$$\begin{array}{l} CH_3-CH-OH \\ \qquad\ \ | \\ \qquad CH_3 \end{array}$$
in this compound alpha carbon is attached with 2 methyl groups so it is secondary alcohol.

Q.3 Primary alcohols are converted into aldehydes by oxidizing agents, so $CH_3CH_2CH_2OH$ is the alcohol to be converted into aldehyde.

Q.4 
$$\begin{array}{c} H \\ | \\ R-C-OH \\ | \\ R \end{array}$$
in this compound α-carbon is attached with 2 alkyl groups so it is secondary alcohol.

Q.5 In the given reaction, C_2H_5Cl, $POCl_3$ and HCl are obtained as a product.

Q.6 Name of the given compound is 2,4,6-trinitrophenol or Picric acid.

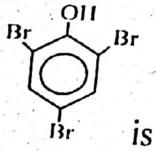
Q.7 

Phenol gives white ppt of 2,4,6-tribromophenol with bromine water

Q.8 Primary, secondary and tertiary alcohols are distinguished by Lucas test in which alcohols react with HCl ($ZnCl_2$ as a catalyst). In the result ter. Alcohols give oily layer immediately while pri. Alcohol gives upon heating.

Q.9 $CH_3-CH_2-OH+PCl_5 \longrightarrow CH_3-CH_2Cl+POCl_3+HCl$ in this reaction formation of HCl is the indication of OH group, which is replaced by Cl ion.

Q.10 All given alcohols are primary in nature and only ethanol is the primary alcohol which gives positive iodoform test.

Q.11 

is the structure of 2,4,6-tribromophenol.

Q.12 Methanol and ethanol both are primary alcohols and can be distinguished by iodoform test which is given positively by ethanol.

Q.13 Formation of iodoform is indicated by yellow ppts.

Q.14 $(CH_3)_3C\text{-}OH$ in tertiary alcohol as 3 methyl groups are attached to alpha carbon.

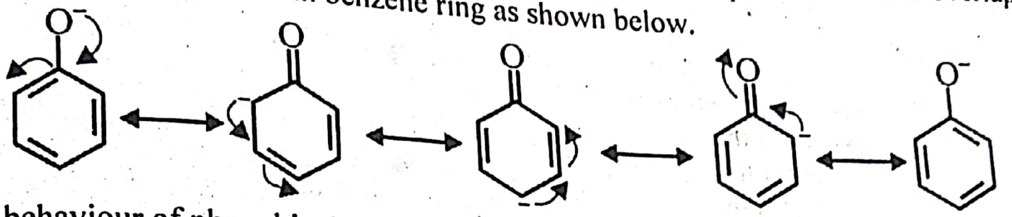
Q.15 $C_2H_5\text{-}SO_4H \xrightarrow[\text{Warm}]{H_2O} C_2H_5\text{-}OH + H_2SO_4$ this is hydration reaction.

Q.16 $CH_3-CH_2-OH+PCl_5 \longrightarrow CH_3-CH_2Cl+POCl_3+HCl$ in this reaction formation of HCl is the indication of OH group, which is replaced by Cl ion.

Q.17 Ethyl acetate (ester) is formed by the reaction of ethanol and acetic acid.

Q.18 At 25°C with phenol 2-4 Dinitrophenol is formed by the reaction of ($HNO_3+H_2SO_4$) with phenol.

Q.19 Phenoxide ion is more stable than alkoxide ion because lone pair on O-atom overlaps with delocalized π-electrons in benzene ring as shown below.



Q.20 Acidic behaviour of phenol is due to nature of phenoxide.

Q.21 Alcohol in which carbon atom bonded to –OH group is further attached with three alkyl group is tertiary alcohol, $(CH_3)_3C\text{-}OH$.

Q.22 $(CH_3)_3C\text{-}OH$, 2-methyl-2-propanol is tertiary alcohol.

Q.23 Electron with drawing effect of ethanoic acid is greater than that of phenol that is why the order of the acidic strength is Ethanoic acid > phenol > ethanol.

Q.24 Ethanol and phenol can be distinguished by bromine water test because it is used to distinguish aliphatic and aromatic hydroxy groups.

Q.25 2,2-dimethyl-1-propanol is the primary alcohol.

Q.26 Dehydration of ethanol at 180°C in the presence of conc-H_2SO_4 gives ethene while at lower temperature it will give ether.

Q.27 Industrially water gas is converted into methanol by using catalyst $ZnO + Cr_2O_3$

Q.28 Phenol reacts with acid halides to give ester as OH group of phenol is involved.

Q.29 Reaction of alcohols with HBr and HI does not require $ZnCl_2$ catalyst due to their greater reactivity than HCl.

Q.30 Tertiary alcohols are not oxidized into carbonyl compounds because they have no alpha-hydrogen.

Q.31 Ketones are obtained by the oxidation of secondary alcohols.

Q.32 Acidified Potassium dichromate (VI) is used to oxidize the secondary alcohols into ketones.

Q.33 Correct name is 2,6- dimethylcyclohexanone. (NOTE: this is the original NMDCAT question, its correct formula must be $C_6H_8O(CH_3)_2$ then B option will be right)

Q.34 Common name of phenol is carbolic acid.

Q.35 Delocalization of negative charge of O-atom in the ring is the reason for the strength of phenol as an acid.

Topic 17

ALDEHYDES AND KETONES

PRACTICE EXERCISE

Q.1 **Carbonyl group is bonded to ________ in ketones**
A. sp^2-hybridized oxygen atom
B. Only one hydrogen atom
C. Only one carbon atom
[✓ D. At least two carbon atoms]

Q.2 **In carbonyl compounds carbonyl carbon is bonded to ________**
A. Oxygen atom through single bond
B. Oxygen atom through peptide bond
C. Oxygen atom through pi-bond
[✓ D. Oxygen atom through a double bond]

Q.3 **Which of the following is correct statement regarding carbonyl compounds**
A. Carbonyl carbon contain no lone pair
B. Carbonyl oxygen contains two lone pair
C. Carbonyl group contains two lone pairs
[✓ D. All of these]

Q.4 **The planar trigonal geometry is associated with**
[✓ A. Formaldehyde]
B. Crotanaldehyde
C. Acetaldehyde
D. Butyraldehyde

Q.5 **Which of the following is unsymmetrical ketone**
A. $(CH_3)_2CO$
B. $C_3H_7COCH_2CH_2CH_3$
C. $C_2H_5OC_2H_5$
[✓ D. $C_2H_5CO(CH_2)_2CH_3$]

Q.6 **Which one is aldehyde**
A. Benzaldehyde
B. Crotonaldehyde
C. Ethanal
[✓ D. All of these]

Q.7 **Which of the following can be used for the oxidative preparation of aldehydes from alcohols**
A. Pt-asbestos
B. FeO and Mo_2O_3
C. $Na_2Cr_2O_7$ and H_2SO_4
[✓ D. All of these]

Q.8 **Which of the following compound is oxidized to get methyl ethyl ketone**
A. 2-Propanol
B. 1-Butanol
[✓ C. 2-Butanol]
D. Tertiary butyl alcohol

Q.9 **Formation of acetaldehyde by ethanol is known as**
A. Reduction
B. Substitution
[✓ C. Oxidation]
D. Elimination

Q.10 **Formaldehyde is prepared by passing ________ and air over platinized asbestos catalyst at 300°C**
A. Formalin vapour
B. Acetone vapour
C. Ethanol vapour
[✓ D. Methanol vapour]

Q.11 **Acidified sodium dichromate oxidizes ethanol to ethanal by producing**
A. Molecular oxygen
B. Ozone
[✓ C. Nascent oxygen]
D. Dichromate ions

Q.12 **Which of the following is true regarding oxidation of an ethanol to an ethanal**
A. – CH_3 is oxidized to CH_2–OH
B. – OH is oxidized to –CO group
C. > CH_2 is oxidized to –CHO group
[✓ D. – CH_2OH is oxidized to –CHO]

Q.13 $H-\boxed{CH_2OH}\xrightarrow[{[O]}]{Na_2Cr_2O_7/H_2SO_4}H-\boxed{X}$ **X is**
[✓ A. An aldehyde group]
B. A carbonyl group
C. A hydroxyl group
D. A carboxyl group

Q.14 **Acetaldehyde is purified by which method when prepared by alcohol in laboratory**
A. Solidification
B. Chromatography
[✓ C. Re-distillation]
D. Steam distillation

Q.15 Isobutyl alcohol on oxidation converts to a carbonyl compound A. A is

A. Butanone B. Butanal
[✓ C. 2-Methyl propanal] D. All of the above

Q.16 Formation of yellow or orange/red precipitates with 2, 4-DNPH refers to the identification of

A. Aldehydes B. Ketones
C. Pure alcohols only [✓ D. Both A. and B.]

Q.17 The reduction of a ketone using $NaBH_4$ gives:

A. Primary alcohol [✓ B. Secondary alcohol]
C. Tertiary alcohol D. Phenol

Q.18 Addition of HCN to acetaldehyde in the presence of dilute mineral acid and sodium cyanide forms

A. Formaldehyde cyanohydrin [✓ B. Acetaldehyde cyanohydrin]
C. Acetone cyanohydrins D. Butanone cyanohydrin

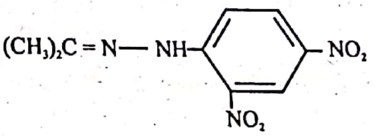
Q.19 What will be the product in following reaction?

$CH_3CH = CHCH_2\,COCH_3 \xrightarrow{NaBH_4} ?$

A. $CH_3CH_2CH_2CH_2COCH_3$ [✓ B. $CH_3CH = CHCH_2CH(OH)CH_3$]
C. $CH_3CH_2CH_2CH_2CH(OH)CH_3$ D. All of these

Q.20 Which of the following has maximum reactivity in nucleophilic addition reactions?

[✓ A. Formaldehyde] B. Propanone
C. Acetaldehyde D. All of these

Q.21 $X + 2,4\text{-DNPH} \xrightarrow[-H_2O]{H^+}$  **, the X will be?**

[✓ A. CH_3COCH_3] B. HCHO
C. CH_3CHO D. $C_2H_5OCH_3$

Q.22 Formation of cyanohydrin form an aldehyde is an example of

A. Nucleophilic substitution B. Electrophilic addition
[✓ C. Nucleophilic addition] D. Electrophilic substitution

Q.23 Reducing agent which attack carbonyl compound in $NaBH_4$ is

A. $\overset{\bullet}{H}$ [✓ B. H^-]
C. H^+ D. H_2

Q.24 Catalytic reduction of acetone will produce

A. Methyl alcohol [✓ B. Isopropyl alcohol]
C. Ethyl alcohol D. Neopentyl alcohol

Q.25 For which one of the following pairs of compounds can be distinguished by means of Tollen's tests.

A. HCHO and CH_3CHO B. CH_3COCH_3 and $CH_3COCH_2CH_3$
[✓ C. CH_3CHO and CH_3COCH_3] D. CH_3COOH and CH_3COCH_3

Q.26 Which substance does not oxidize easily

A. CH_3CH_2CHO B. HCHO
C. CH_3CHO [✓ D. CH_3COCH_3]

Q.27 Which one of the following set of compounds oxidize aldehydes as well as ketones

A. $CuSO_4 + NaOH +$ Citric acid B. $AgNO_3 + NH_4OH$
C. $CuSO_4 + NaOH +$ Tartaric acid [✓ D. $K_2Cr_2O_7 +$ Conc. H_2SO_4]

Q.28 An aldehyde when boiled with Fehling solution gives brick red precipitate, red colour is due to

A. Ag

B. Cupric oxide

●. Cuprous oxide

D. Sodium carboxylate

Q.29 Strongest reducing agent that can reduce the Tollen's reagent is

●. HCHO

B.

C. CH_3CHO

D. CH_3COCH_3

Q.30 Which of the following carbonyl compound can give aliphatic, saturated alcohol using $NaBH_4$

A. Acetophenone

B. Benzaldehyde

C. 2-Butene, 2-ol

●. 3-Methyl 2-pentanone

Q.31 Acetaldehyde gives which salt by reacting with ammonical silver nitrate

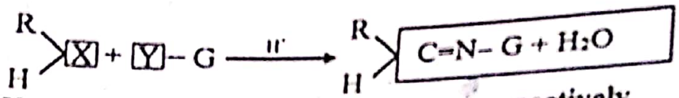
A. Sodium acetate

●. Ammonium acetate

C. No salt formed

D. Silver chloride

Q.32



$$\overset{R}{\underset{H}{>}}\boxed{X} + \boxed{Y}-G \xrightarrow{H^+} \overset{R}{\underset{H}{>}}\boxed{C=N-G+H_2O}$$

X and Y in this reaction are ______ respectively

A. $-NH_2$ and $-CHO$

B. $-CHO$ and $-NH_2$

●. $> C = O$ and $-NH_2$

D. $-CH_2OH$ and $-NH_2$

Q.33 Formalin is __________ % solution of formaldehyde in water

A. 10%

B. 20%

●. 40%

D. 60%

Q.34 Which of the following carbonyl compounds shows rapid reaction with sodium nitroprusside

A. Formaldehyde

B. Acetaldehyde

C. Benzaldehyde

●. Acetone

Q.35 Cannizzaro's reaction is not given by

A. Formaldehyde

●. Acetaldehyde

C. Benzaldehyde

D. Trimethyl acetaldehyde

Q.36 Which of the following do not give aldol condensation reactions

●. Formaldehyde

B. Acetaldehyde

C. Diemthyl ketone

D. Propionaldehyde

Q.37 Which of the following will not give addition reaction with $NaHSO_3$

A. HCHO

B. CH_3CHO

C. CH_3-CH_2-CHO

●. CH_3CH_2-OH

Q.38 For aldol condensation the conditions necessary

A. α-C

B. α-H

C. Basic medium

●. All of these

Q.39 Which of the following does not give aldol condensation

●. Methanal

B. Ethanal

C. Propanone

D. 2-pentanone

Q.40 Which of the following compound can be used for the separation of ethanal from the mixture of ethanal and ethanol

●. $NaHSO_3$

B. HCN

C. NH_2NH_2

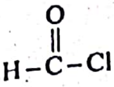
D. Aldol

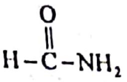
PAST PAPER QUESTIONS

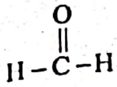
Q.1 **Brick red precipitate are formed when aldehyde reacts with:** MDCAT (2010)

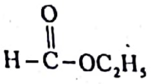
A. Sodium borohydride
[✓ B]. Fehling solution
C. Sodium bisulphate
D. Formaldehyde

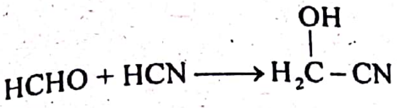
Q.2 **Which of the following compounds belong to homologous series of aldehydes** MDCAT (2011)

A. 
$H-\overset{O}{\overset{\|}{C}}-Cl$

B. 
$H-\overset{O}{\overset{\|}{C}}-NH_2$

[✓ C]. 
$H-\overset{O}{\overset{\|}{C}}-H$

D. 
$H-\overset{O}{\overset{\|}{C}}-OC_2H_5$

Q.3 
$HCHO + HCN \longrightarrow H_2\overset{OH}{\overset{|}{C}}-CN$ **in the above reaction nucleophile is** MDCAT (2011)

[✓ A]. CN^-
B. HCl
C. Cl^-
D. OH^-

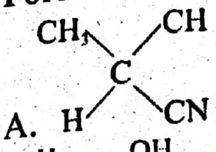
Q.4 **Consider the following reaction:**
$R-CHO + 2[Ag(NH_3)_2]OH \dashrightarrow RCOONH_4 + 2Ag + 2NH_3 + H_2O$
this reaction represents which of the following tests MDCAT (2011)

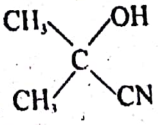
A. Fehling test
B. Benedict test
C. Ninhydrin test
[✓ D]. Tollen's test

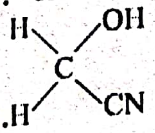
Q.5 **With acidified $Na_2Cr_2O_7$, what the product will be, when secondary alcohols are oxidized in same conditions?** MDCAT (2012)

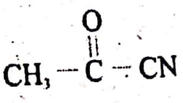
A. Alkenes
B. Alkyl halides
C. Alkynes
[✓ D]. Ketones

Q.6 **Formaldehyde reacts with HCN (NaCN + HCl) to give a compound** MDCAT (2012)

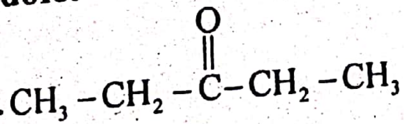
A. 

B. 

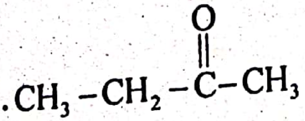
[✓ C]. 

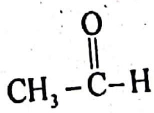
D. 
$CH_3-\overset{O}{\overset{\|}{C}}-CN$

Q.7 **Iodoform test will not be positive with** MDCAT (2012)

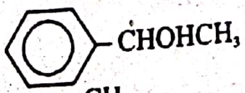
[✓ A]. 
$CH_3-CH_2-\overset{O}{\overset{\|}{C}}-CH_2-CH_3$

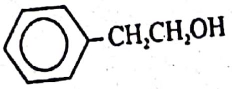
B. C_2H_5OH

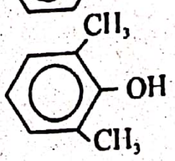
C. 
$CH_3-CH_2-\overset{O}{\overset{\|}{C}}-CH_3$

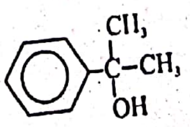
D. 
$CH_3-\overset{O}{\overset{\|}{C}}-H$

Q.8 **What is the structure of alcohol which on oxidation with acidified $Na_2Cr_2O_7$ gives C_6H_5-CO-CH_3.** MDCAT (2013)

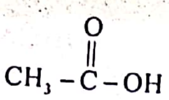
[✓ A]. 

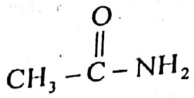
B. 

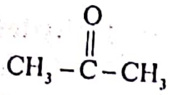
C. 

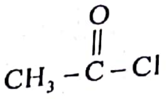
D. 

Q.9 **Which of the following is the structure of a ketone?** MDCAT (2013)

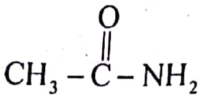
A.

$CH_3-\overset{O}{\overset{||}{C}}-OH$

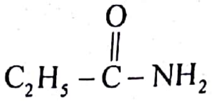
B.

$CH_3-\overset{O}{\overset{||}{C}}-NH_2$

[✓ C.]

$CH_3-\overset{O}{\overset{||}{C}}-CH_3$

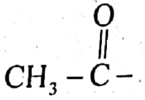
D.

$CH_3-\overset{O}{\overset{||}{C}}-Cl$

Q.10 **Which group gives a yellow precipitate of triiodomethane when warmed with alkaline aqueous iodine?** MDCAT (2013)

A. An amide group,

$CH_3-\overset{O}{\overset{||}{C}}-NH_2$

B. Ethyl ketone group,

$C_2H_5-\overset{O}{\overset{||}{C}}-NH_2$

C. A primary alcohol group as in propanol, $CH_3CH_2CH_2OH$

[✓ D.] Methyl ketone group,

$CH_3-\overset{O}{\overset{||}{C}}-$

Q.11 **A student mixed ethyl alcohol with small amount of sodium dichromate and added it to the hot solution of dilute sulphuric acid. A vigorous reaction took place. He distilled the product formed immediately. What was the product?** MDCAT (2014)

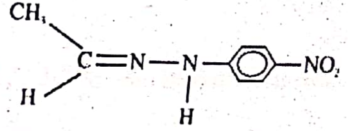
A. Acetone

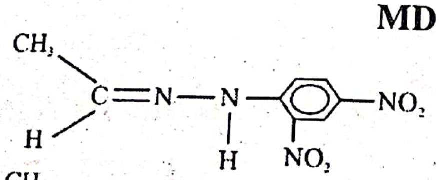
B. Dimethyl ether

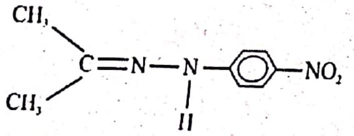
C. Acetic acid

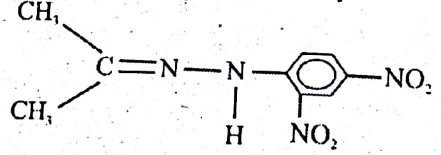
[✓ D.] Acetaldehyde

Q.12 **The structure of formula of the product of reaction of acetone with 2, 4-dinitrophenyl hydrazine is** MDCAT (2014)

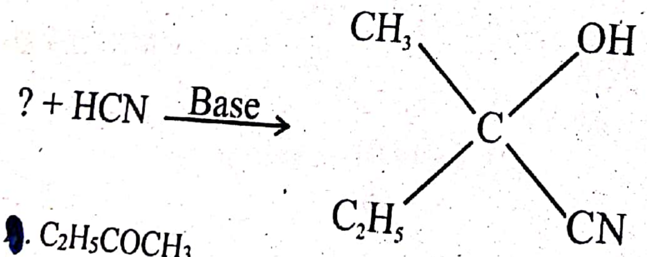
A.


B.


C.


[✓ D.]


Q.13 **For the reaction:** MDCAT (2014)



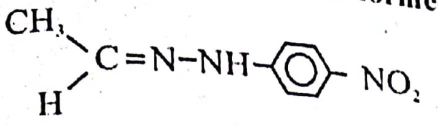
[✓ A.] $C_2H_5COCH_3$

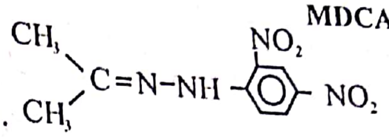
B. CH_3COCH_3

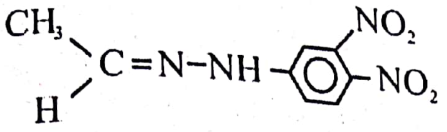
C. $C_2H_5CH(CH_3)OH$

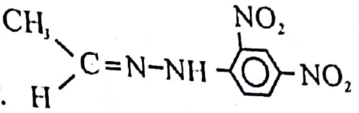
D. $C_2H_5CH_2CHO$

Q.14 **When acetaldehyde reacts with 2,4–dinitrophenylhydrazine (2,4-DNPH), which one of the following products is formed** MDCAT (2015)

A.


B.


C.


[✓ D.]


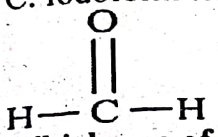
Q.15 **Both aldehydes and ketones are planer to the neighborhoods of carbonyl $\left(>C=O\right)$ group. Which one of the following bonds is distorted towards the oxygen atoms?**

MDCAT (2015)

[✓ A. π bond of C and O]
B. Sigma bond of C and O
C. Sigma bond of C and H
D. Sigma bond of C and C

Q.16 **Which one of the following is also called silver mirror test** MDCAT (2015)

A. Fehling's solution test
[✓ B. Tollen's reagent]
C. Iodoform test
D. Benedict's solution tests

Q.17

$$H-\overset{\overset{\displaystyle O}{\|}}{C}-H$$

Which one of the following is IUPAC name of the above given structure?

MDCAT (2016)

A. Proopanaldehyde
B. Acetaldehyde
C. Methanone
[✓ D. Methanal]

Q.18 **$R-CH=N-NH-C_6H_3(NO_2)_2$ It is a general formula of:** MDCAT (2016)

A. 2,4 dinitrophenyl hydrazine
B. Phenyl hydrazone
C. 1,3 dinitrophenyl hydrazone
[✓ D. 2,4 dinitrophenyl hydrazone]

Q.19 **Which one of the following test is given by both aldehyde and ketone?**

MDCAT (2016)

A. Silver mirror test
[✓ B. 2,4 DNPH test]
C. Fehling's solution test
D. Benedict's solution test

Q.20 **In the reaction, "?" represents which one of the following products:** MDCAT (2017)

$$\text{Primary Alcohol}+[O]\xrightarrow[H_2SO_4]{K_2Cr_2O_7}\underline{\quad ?\quad}\xrightarrow{[O]}\text{Carboxylic Acid}$$

A. Ketone
B. Formic acid
[✓ C. Aldehyde]
D. Ether

Q.21 **The reaction of aldehydes and ketones with ammonia derivative G-NH₂ to form compounds containing the group $>C=N-G$ and water is known as ________ reaction.**

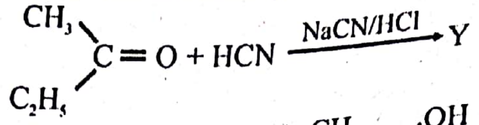
MDCAT (2017)

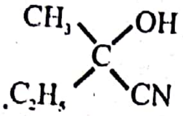
A. Nucleophilic addition
B. Electrophilic addition
C. Nucleophilic substitution
[✓ D. Addition Elimination]

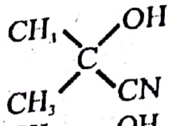
Q.22 **Ethanal reacts with HCN to form cyanohydrin. It is an example of** **MDCAT (2017)**

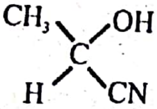
[✓ A.] Nucleophilic addition
B. Electrophilic substitution
C. Electrophilic addition
D. Nucleophilic substitution

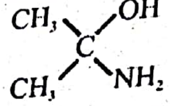
Q.23 **What will be the product of the reaction given below?** **MDCAT (2017)**



[✓ A.]


B.


C.


D.


Q.24 **Which one of the following compounds will give iodoform test on treatment with aqueous iodine?** **MDCAT (2017)**

A. 3-pentanone
B. Propanal
[✓ C.] Propanone
D. Butanal

Q.25 **2-propanal on Oxidation gives ______________:** **MDCAT (2017)**

A. Aldehyde
B. Carboxylic Acid
[✓ C.] Ketone
D. Alcohol

Q.26 **Both aldehyde and ketones give ______________:** **MDCAT (2017)**

A. Tollen's Test
B. Benedict's solution test
[✓ C.] 2,4-DNPH test
D. Sodium nitroprusside test

Q.27 **Which reagent is responsible for the conversion of ketone to secondary alcohol:** **MDCAT (2017)**

A. $NaAlH_4$
B. Al
[✓ C.] $NaBH_4$
D. Red P

Q.28 **To distinguish aldehyde from ketone which solution is used:** **MDCAT (2017)**

A. Alkaline solution
B. A solution containing $K_2Cr_2O_7$
[✓ C.] Fehling's solution
D. A solution containing acid only

Q.29 **Identify the compound, which give iodoform test:** **MDCAT (2017)**

A. Methanol
B. 3- Hexanol
[✓ C.] Methyl ketone
D. Propionaldehyde

Q.30 **Why is it necessary to distill aldehyde formed from oxidation of primary alcohol through acidified per dichromate (VI) solution or acidified sodium dichromate (VI) solution?** **MDCAT (2018)**

A. Aldehyde formed is unstable and decompose back to original precursor i.e. primary alcohol
B. Aldehyde formed may react with primary alcohol, the original reactant
C. Aldehyde may be oxidized further to a ketone
[✓ D.] Aldehyde formed may be oxidized further to carboxylic acid

Q.31 $H_3C-CH_2-OH \xrightarrow[H_2SO_4]{K_2Cr_2O_7} M \xrightarrow{AgNO_3/NH_4OH} N$

What is the final indication in given reaction **SET (2019)**

A. Blue precipitate
[✓ B.] Silver mirror
C. Red precipitate
D. White precipitate

Q.32 **Which of the following compounds will produce a yellow precipitate with I_2 dissolved in $NaOH_{(aq)}$?** SET (2019)

A. $HCOOCH_2CH_2$
[✓ B. $CH_3CH_2CO\ CH_3$]
C. CH_3OH
D. CH_3CH_2CHO

Q.33 **Which of the following reagent is used distinguished between $CH_3CH_2CHOHCH_2OH$ and $CH_3CH_2CHOHCH_2CHO$** SET (2019)

[✓ A. 2,4-DNPH (dinitrophenyl hydrazine)]
B. Dilute sulfuric acid
C. Potassium maganate
D. Tollen's reagent

Q.34 **Which one of the following reagents can be used to detect an aldehyde ?** SET (2019)

A. Tetraethyl lead
B. Alcoholic KOH
C. Acidified Cu_2Cl_2
[✓ D. Tollen's reagent]

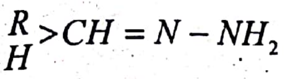
Q.35 **Hybridization of carbon in –CHO group is** NUMS (2019)

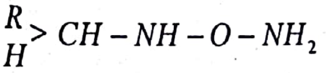
A. sp
[✓ B. sp^2]
C. sp^3
D. dsp

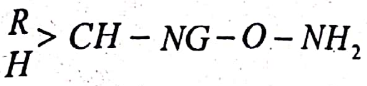
Q.36 **Carbonyl group undergo** NUMS (2019)

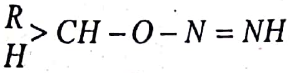
A. Electrophilic addition reaction
[✓ B. Nucleophilic addition reaction]
C. Electrophilic substitution reaction
D. Nucleophilic substitution reaction

Q.37 **The compound Aldehyde hydrazine is** ETEA (2016)

[✓ A.] 
$\begin{matrix}R\\H\end{matrix}\!>CH=N-NH_2$

B. 
$\begin{matrix}R\\H\end{matrix}\!>CH-NH-O-NH_2$

C. 
$\begin{matrix}R\\H\end{matrix}\!>CH-NG-O-NH_2$

D. 
$\begin{matrix}R\\H\end{matrix}\!>CH-O-N=NH$

Q.38 **Which one is more reactive?** ETEA (2019)

[✓ A. HCHO]
B. CH_3CHO
C. $(CH_3)_2CO$
D. Have equal reactivity

Q.39 **Hydration of hydrocarbon give carbonyl compound, the general formula of that hydrocarbon is** ETEA (2019)

A. C_nH_{2n+2}
B. C_nH_{2n}
[✓ C. C_nH_{2n-2}]
D. Both b and c

Q.40 **Identification test for functional groups of organic compounds are associated with specific observations. Tollen's reagent is ammonical silver nitrate solution, which is used for the identification of a functional group X with an observation O. Identify X and O.** MDCAT (2019)

A. X = Aldehyde O = red precipitate
B. X = Ketone O = Silver mirror
[✓ C. X = Aldehyde O = Silver mirror]
D. X = Ketone O = grey precipitate

Q.41 **Which of the following will give a positive test with Tollen's reagent?** MDCAT (2019)

A. Tertiary Alcohols
B. Ketones
[✓ C. Aldehydes]
D. Carboxylic Acids

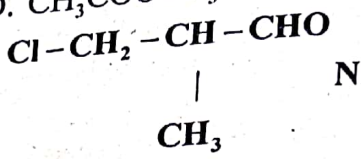
Q.42 **Which type of reaction takes place when a carbonyl compound is treated with a mixture of NaCN and an acid?** MDCAT (2019)

A. Electrophilic addition reaction
B. Displacement reaction
[✓ C. Nucleophilic addition reaction]
D. Substitution reaction

Q.43 **Which of the following compounds will give a secondary alcohol after reaction with $NaBH_4$?** **MDCAT (2019)**

[✓ A.] CH_3COCH_3
B. CH_3CH_2CHO
C. CH_3CH_2COOH
D. CH_3COOCH_3

Q.44 **The common name of following aldehyde is** **NMDCAT (2020)**

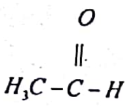

$$Cl-CH_2-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CHO$$

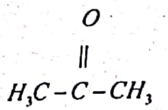
A. α-Methyl-γ-Chloro propionaldehyde
B. β-Chloro-γ-Methyl propionaldehyde
[✓ C.] β-Chloro-α-Methyl propionaldehyde
D. β-Methyl-α-Chloro propionaldehyde

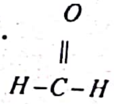
Q.45 **Which of the following reagent is use to separate and purify carbonyl and non-carbonyl compounds?** **NDMCAT (2020)**

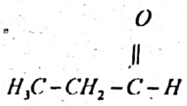
A. HCN
B. BrMgCH2
[✓ C.] $NaHSO_3$
D. H_2O

Q.46 **Secondary alcohol is the product of reduction of which carbonyl compound?** **NMDCAT (2020)**

A.

$$H_3C-\overset{\overset{\displaystyle O}{||}}{C}-H$$

[✓ B.]

$$H_3C-\overset{\overset{\displaystyle O}{||}}{C}-CH_3$$

C.

$$H-\overset{\overset{\displaystyle O}{||}}{C}-H$$

D.

$$H_3C-CH_2-\overset{\overset{\displaystyle O}{||}}{C}-H$$

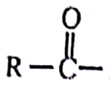
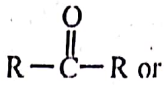
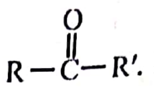
ANSWER KEY

1	D	11	C	21	A	31	B
2	D	12	D	22	C	32	C
3	D	13	A	23	B	33	C
4	A	14	C	24	B	34	D
5	D	15	C	25	C	35	B
6	D	16	D	26	D	36	A
7	D	17	B	27	D	37	D
8	C	18	B	28	C	38	D
9	C	19	B	29	A	39	A
10	D	20	A	30	D	40	A

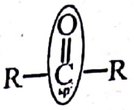
PAST PAPERS QUESTIONS

1	B	6	C	11	D	16	B	21	D	26	C	31	B	36	B	41	C	46	B
2	C	7	A	12	D	17	D	22	A	27	C	32	B	37	A	42	C		
3	A	8	A	13	A	18	D	23	A	28	C	33	A	38	A	43	A		
4	D	9	C	14	D	19	B	24	C	29	C	34	D	39	C	44	C		
5	D	10	D	15	A	20	C	25	C	30	D	35	B	40	C	45	C		

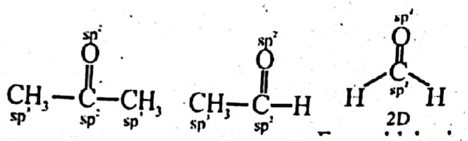
EXPLANATORY NOTES

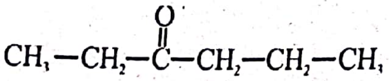
Q.1 Carbonyl compounds include aldehyde and ketones. Aldehydes have structural formula  $R-\overset{O}{\overset{\|}{C}}-H$ while ketones have  $R-\overset{O}{\overset{\|}{C}}-R$ or  $R-\overset{O}{\overset{\|}{C}}-R'$. In ketones C=O is attached with two C-atoms or R groups

Q.2 In carbonyl compounds C-atom is attached with O-atom though double bond.

Q.3 The general structure is formula of ketone is  $R-\overset{O}{\overset{\|}{C}}-R$. The carbonyl group $>C=O$ is bonded to two alkyl groups means to C atoms

Q.4 Mostly in saturated and aliphatic carbonyl compounds the carbonyl carbon is bonded to one or two sp^3 hybridized carbon atoms but formaldehyde is bonded with 2 hydrogen atoms making trigonal planer structure (purely planer)



Q.5 The unsymmetrical ketones have two different alkyl groups on either side of carbonyl group like  $CH_3-CH_2-\overset{O}{\overset{\|}{C}}-CH_2-CH_2-CH_3$

Q.6 All compounds have –CHO group. Therefore, all the compounds are aldehydes

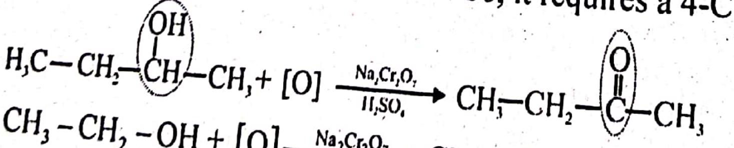
Q.7 $2CH_3OH+O_2\xrightarrow[500°C]{FeO,Mo_2O_3}2HCHO+2H_2O$

$2CH_3OH+O_2\xrightarrow[300°C]{Pt\text{-}Asbestos}2HCHO+2H_2O$

$CH_3-CH_2-OH+[O]\xrightarrow[H_2SO_4]{Na_2Cr_2O_7}CH_3CHO+H_2O$

FeO, Mo_2O_3 and Pt-asbestos are catalysts used for air oxidation of alcohols to aldehydes while $Na_2Cr_2O_7$ + H_2SO_4 combination is used for the production of nascent oxygen which is used to oxidize alcohols to carbonyl compounds.

Q.8 Methyl ethyl ketone is a 4-C ketone. So, it requires a 4-C secondary alcohols



$H_3C-CH_2-\overset{OH}{CH}-CH_3+[O]\xrightarrow[H_2SO_4]{Na_2Cr_2O_7}CH_3-CH_2-\overset{O}{\overset{\|}{C}}-CH_3$

Q.9 $CH_3-CH_2-OH+[O]\xrightarrow[H_2SO_4]{Na_2Cr_2O_7}CH_3-CHO$

This reaction is involving oxidation of ethanol

Q.10 $2CH_3OH_{(g)}+O_{2(g)}\xrightarrow[300°C]{Pt\text{-}Asbestos}2HCHO_{(g)}+2H_2O_{(g)}$

Q.11 $Na_2Cr_2O_7+4H_2SO_4\longrightarrow Na_2SO_4+Cr_2(SO_4)_3+4H_2O+3[O]$

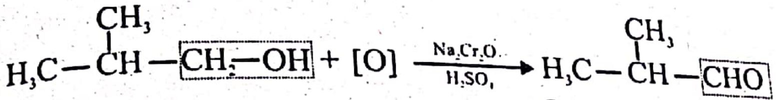
$3C_2H_5OH+3[O]\longrightarrow 3CH_3CHO+3H_2O$

Q.12 $H_3C-\boxed{CH_2-OH}+[O]\xrightarrow[H_2SO_4]{Na_2Cr_2O_7}H_3C-\boxed{CHO}+H_2O$

Q.13 $H-\boxed{\overset{\alpha}{C}H_2-OH}+[O]\xrightarrow[H_2SO_4]{Na_2Cr_2O_7}H-\underset{\text{Aldehyde group}}{\boxed{CHO}}+H_2O$

Q.14 During the oxidation of ethanol to get a acetaldehyde, acetaldehyde is immediately distilled off to avoid its oxidation. This distillate (mixture of ethanol, water and acetaldehyde) is then condensed. To get pure acetaldehyde, it is redistilled

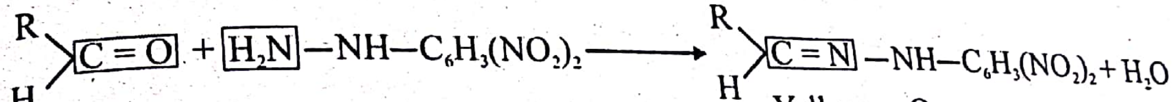
Q.15 Isobutyl alcohol is primary alcohol



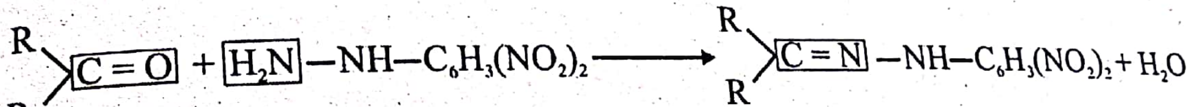
$H_3C-\overset{CH_3}{\overset{|}{C}H}-\boxed{CH_2-OH}+[O]\xrightarrow[H_2SO_4]{Na_2Cr_2O_7}H_3C-\overset{CH_3}{\overset{|}{C}H}-\boxed{CHO}$

2-Methyl propanal

Q.16 The aldehydes and ketones give yellow or orange colour crystals (2,4-dinitrophenylhydrozone)

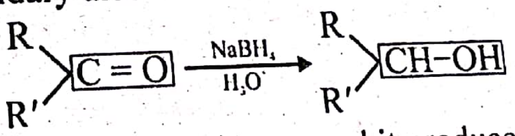


Yellow or Orange



Yellow or Orange

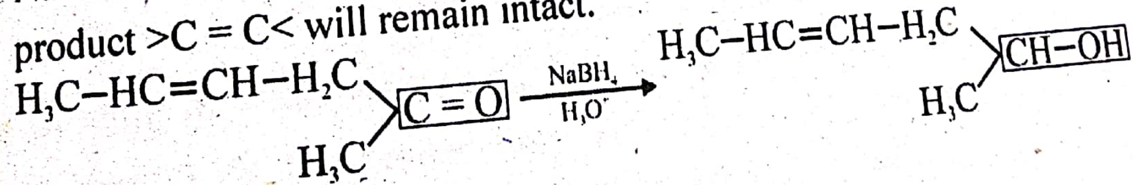
Q.17 The reduction of any ketone by NaBH4, LiAlH4 or H2 (in presence of Ni / Pt / Pd catalyst) produces secondary alcohol $> C = O$ is reduced to $> CH - OH$



Q.18 When HCN is added to any carbonyl compound it produces an adduct which contain both –CN group and –OH group attached to one carbon, called cyanohydrin.

$$R-CHO+HCN\xrightarrow[HCl]{NaCN}R-CH(OH)(CN)$$

Q.19 NaBH4 can reduce >C = O group to >CH–OH group but cannot reduce >C=C<. So, in product >C = C< will remain intact.



Q.20

Reactivity order:

Aldehyde > Ketone

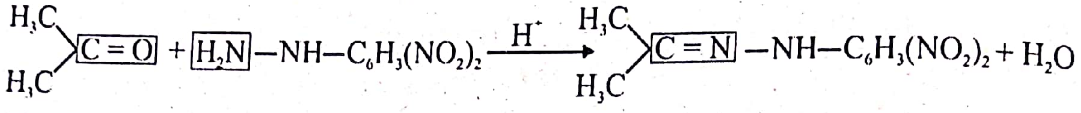
Small aldehyde > large aldehyde

Small ketone >large ketone

Unsymetrical ketone > symmetrical ketone

Aliphatic aldehyde / ketone > aromatic aldehyde / ketone

Q.21 X is acetone because 2,4 dinitrophenylhydrazone contains two –CH_3 groups.



$$(H_3C)_2\boxed{C=O} + \boxed{H_2N}-NH-C_6H_3(NO_2)_2 \xrightarrow{H^+} (H_3C)_2\boxed{C=N}-NH-C_6H_3(NO_2)_2 + H_2O$$

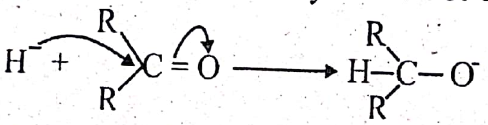
Q.22 The formation of cyanohydrin is achieved by addition of HCN to carbonyl compounds. As this addition is initiated by the attack of –CN^- to carbonyl carbon of carbonyl compound. Therefore, it is a nucleophilic addition reaction.

Q.23

$$NaBH_4 \longrightarrow Na^+ + BH_4^-$$

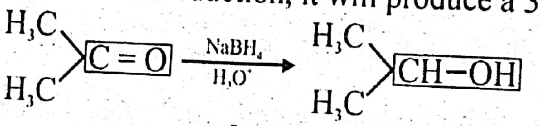
$$BH_4^- \longrightarrow BH_3 + H^-$$

H^- is reducing agent because it reduces carbonyl carbon of carbonyl compound.



$$H^- + R_2C=O \longrightarrow H-CR_2-O^-$$

Q.24 Acetone is a 3–C ketone. On reduction, it will produce a 3–C secondary alcohol.



$$(H_3C)_2\boxed{C=O} \xrightarrow[H_3O^+]{NaBH_4} (H_3C)_2\boxed{CH-OH}$$

Isopropyl alcohol / 2-Propanol

Q.25 All the aliphatic aldehydes gives positive test (silver mirror formation on the inner side of test tube) while ketones don't. So, any aliphatic aldehyde can be distinguished from ketones by Tollen's test.

Q.26 Ketones are reluctant towards oxidation

Q.27 A, B, C are weak oxidizing agent, so they can oxidize aldehydes only (due to high reactivity than ketone) but not ketones but the combination of $K_2Cr_2O_7$ and H_2SO_4 produces nascent oxygen which is very strong oxidizing agent. So, it can oxidize both aldehydes and ketones.

Q.28 Fehling's solution is alkaline solution containing cupric tartarate complex ion. This cupric ion reduced to brick red coloured cuprous oxide (Cu_2O) by an aliphatic aldehyde.

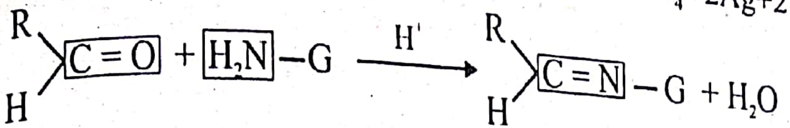
Q.29 Aliphatic aldehydes are reactive than aromatic aldehydes and ketones so, a small aliphatic aldehyde can reduce Tollen's reagent

Q.30 3-Methyl-2-pentanone gives 3-Methyl-2-pentanol on reduction with $NaBH_4$

$CH_3CH_2CH(CH_3)COCH_3 \xrightarrow{NaBH_4} CH_3CH_2CH(CH_3)CH(OH)CH_3$

Q.31 $CH_3CHO+2\left[Ag(NH_3)_2\right]OH \longrightarrow CH_3COONH_4+2Ag+2NH_3+H_2O$

Q.32



$$\overset{R}{\underset{H}{>}}\boxed{C=O} + \boxed{H_2N}-G \xrightarrow{H^+} \overset{R}{\underset{H}{>}}\boxed{C=N}-G + H_2O$$

Q.33 Formalin contains 40% formaldehyde, 8% methanol and 52% water.

Q.34 Ketones produce a wine red or orange red colour on adding alkaline sodium nitroprusside solution dropwise. Aldehydes don not give this test.

Q.35 Aldehydes that have no α-hydrogen atoms undergo cannizzaro's reaction. Acetaldehyde possess α-hydrogen therefore it does not give Cannizzaro's reaction.

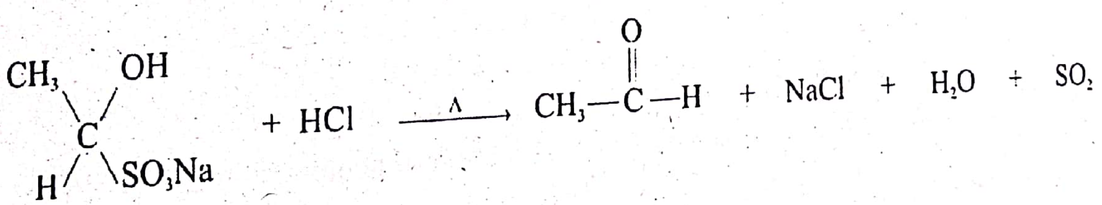
Q.36 Aldehydes and ketones possessing α-hydrogen atoms react with a cold dilute solution of an alkali to form addition products known as aldols. Formaldehyde has no α-hydrogen therefore it does not give aldol condensation reaction.

Q.37 Aldehydes and small methyl ketones react with a saturated aqueous solution of sodium bisulphite to form a crystalline white precipitate of sodium bisulphite adduct. Alcohols do not react with $NaHSO_3$.

Q.38 Aldehydes and ketones possessing α-hydrogen atoms react with a cold dilute solution of an alkali to form addition products known as aldols.

Q.39 Aldehydes and ketones possessing α-hydrogen atoms react with a cold dilute solution of an alkali to form addition products known as aldols. Methanal has no α-hydrogen therefore it does not give aldol condensation reaction.

Q.40



$$CH_3(H)C(OH)(SO_3Na) + HCl \xrightarrow{\Delta} CH_3-\overset{\overset{\large O}{\|}}{C}-H + NaCl + H_2O + SO_2$$

Bisulphite addition product Acetaldehyde

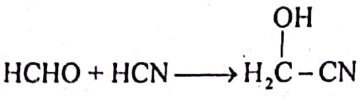
This reaction is used for the separation and purification of carbonyl compounds from non-carbonyl compounds such as alcohols.

EXPLANATORY NOTES»

(PAST PAPER QUESTIONS)

Q.1 Brick red precipitate are formed when aldehyde reacts with fehling solution

Q.2 Formaldehyde (HCOH) belongs to homologous series of aldehydes.

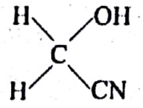
Q.3 
$HCHO + HCN \longrightarrow H_2\overset{\overset{OH}{|}}{C}-CN$, CN^{-1} is the nucleophile in this reaction.

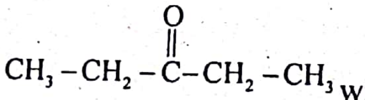
Q.4 $R\text{-}CHO + 2\left[Ag(NH_3)\right)_2]OH \longrightarrow RCOONH_4 + 2Ag + 2NH_3 + H_2O$

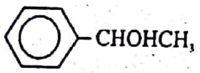
is the representation of tollen's reagent or silver mirror test.

Q.5 Ketones are obtained during oxidation of secondary alcohols with acidified $Na_2Cr_2O_7$.

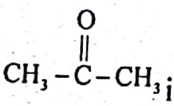
Q.6 Formaldehyde reacts with HCN (NaCN + HCl) to give



Q.7 
$CH_3-CH_2-\overset{\overset{O}{||}}{C}-CH_2-CH_3$ will not give positive iodoform test.

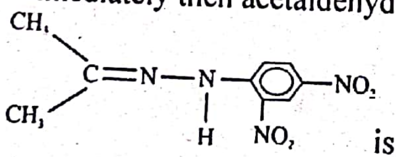
Q.8 

is the oxidation product of $C_6H_5\text{-}CO\text{-}CH_3$.

Q.9 
$CH_3-\overset{\overset{O}{||}}{C}-CH_3$ is the structure of ketone.

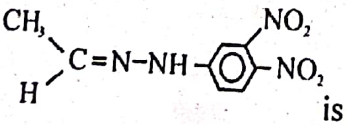
Q.10 Methyl ketones (CH_3CO-) give positive iodoform test.

Q.11 Ethanol gives acetic acid upon oxidation with sod.dichromate, if reaction is distilled immediately then acetaldehyde is obtained.

Q.12 

is obtained by the reaction of acetone and 2,4-DNPH.

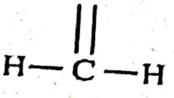
Q.13 Acetone reacts with HCN to form cyanohydrin.

Q.14 

is product of acetaldehyde and 2,4DNPH test.

Q.15 π bond of C and O is more distorted towards oxygen due to presence of lone pair.

Q.16 Tollen's reagent is also called silver mirror test.

Q.17 
$H-\overset{\overset{O}{||}}{C}-H$ is aldehydic group with one carbon called methanal.

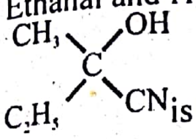
Q.18 $R\text{-}CH{=}N\text{-}NH\text{-}C_6H_3(NO_2)_2$ It is a general formula of 2,4-dinitrophenylhydrazone.

Q.19 2,4-DNPH test is given by both aldehydes and ketones.

Q.20 $\text{Primary Alcohol} + [O] \xrightarrow[H_2SO_4]{K_2Cr_2O_7} ? \xrightarrow{[O]} \text{Carboxylic Acid}$, in the given reaction "?" is aldehyde.

Q.21 The reaction of aldehydes and ketones with ammonia derivative G-NH_2 to form compounds containing the group $>C=N-G$ and water is known as addition elimination reaction.

Q.22 Ethanal and HCN give ethanal cyanohydrin under the nucleophillic addition reaction.

Q.23 
is the final product of given reaction

Q.24 In the given compounds propanone will give positive iodoform test

Q.25 2-propanol is the secondary alcohol and gives ketone upon oxidation.

Q.26 2,4-DNPH test is given by both aldehydes and ketones.

Q.27 $NaBH_4$ is used to partially reduce the ketones to get sec. alcohol

Q.28 Fehling solution is used to distinguish between aldehydes and ketones, as aldehyde gives positive fehling solution test.

Q.29 Methyl ketones gives positive iodoform test.

Q.30 Aldehydes produced during the oxidation of primary alcohols are converted to carboxylic acid if not distilled immetiatly.

Q.31 $H_3C-CH_2-OH \xrightarrow[H_2SO_4]{K_2Cr_2O_7} M \xrightarrow{AgNO_3/NH_4OH} N$, here M is an aldehyde while N is silver mirror, as aldehydes give positive silver mirror test.

Q.32 Butanone (CH_3-CH_2-CO-CH_3) gives positive iodoform test.

Q.33 2,4-DNPH will give positive test with $CH_3CH_2CHOHCH_2CHO$ due to presence of aldehyde group.

Q.34 Tollen's reagent is used to distinguish or detect the aldehydes

Q.35 Carbonyl carbon in aldehydes and ketones is sp^2 hybridized.

Q.36 Carbonyl compounds undergo nucleophillic addition reaction.

Q.37 ${}^{R}_{H}\!>CH=N-NH_2$ is the structure of aldehyde hydrazine.

Q.38 Aldehydes are more reactive than ketones, due to less steric hinderence. Formaldehyde is the most reactive among all.

Q.39 Alkynes give carbonyl compounds upon hydration having general formula C_nH_{2n-2}.

Q.40 X = Aldehydes, O = Silver mirror in the given reaction.

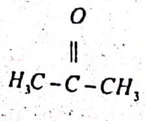
Q.41 Aldehydes give positive silver mirror test.

Q.42 Nucleophilic addition reaction takes place when a carbonyl compound is treated with a mixture of NaCN and an acid.

Q.43 CH_3COCH_3 will give secondary alcohol with $NaBH_4$.

Q.44 β-Chloro-α-Methyl propionaldehyde is the common name of given compound.

Q.45 $NaHSO_3$ is used to separate the carbonyl compounds from others.

Q.46 
$H_3C-\overset{\overset{O}{\|}}{C}-CH_3$ is ketone and give sec. alcohol upon reduction.

Topic 18

CARBOXYLIC ACIDS

PRACTICE EXERCISE

Q.1 **General formula for carboxylic acid is**
A. $C_nH_{2n}O_3$
B. $C_nH_nO_2$
[✓ C. $C_nH_{2n}O_2$]
D. $C_nH_{2n}O$

Q.2 **Which of the following is an unsaturated carboxylic acid**
A. Malonic acid
B. Oxalic acid
C. Succinic acid
[✓ D. Maleic acid]

Q.3 **Acetic acid exists as dimer in benzene due to**
A. Presence of hydrogen at ∝-carbon
B. Condensation reaction
C. Presence of carboxylic group
[✓ D. Hydrogen bonding]

Q.4 **An acid with unpleasant smell**
A. Formic acid
B. Acetic acid
C. Propionic acid
[✓ D. Butyric acid]

Q.5 **Glacial acetic acid at low temperature is a**
A. Semi solid
[✓ B. Ice like solid]
C. Viscous liquid
D. Dilute liquids

Q.6 **Which of the following is unsaturated aliphatic organic acid**
[✓ A. Maleic acid]
B. Terephthalic acid
C. Phthalic acid
D. Adipic acid

Q.7 **Which one is carboxylic acid**
A. Carbolic acid
B. Picric Acid
C. Carbonic Acid
[✓ D. Palmitic acid]

Q.8 **Organic acid which cannot obtained by hydrolysis of fats**
[✓ A. Succinic acid]
B. Acetic acid
C. Butyric acid
D. Propionic acid

Q.9 **By oxidation of which compound carboxylic acid cannot be obtained.**
[✓ A. 2-Methyl-2-propanol]
B. 1-Butanol
C. 2-Butanol
D. 2-Propanol

Q.10 **A compound is oxidized to X, by further oxidation of X if resulting compound is butyric acid, starting compound can be:**
[✓ A. Butanol]
B. Butanoic acid
C. Butanone
D. All of these

Q.11 **Alkane nitriles on boiling with which type of acid gives organic acids**
A. Organic
B. Phenol
C. Alcohol
[✓ D. Mineral acids]

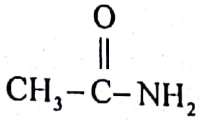
Q.12 **If ethanoic acid is to be prepared by hydrolysis of alkane nitriles, which of the following can be the reagent to be hydrolyzed**
[✓ A. CH_3CN]
B. CH_3CH_2CN
C. HCN
D. NaCN + HCl

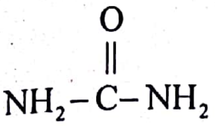
Q.13 **Alkane nitriles can be prepared by treating alkyl halide with**
A. Alcohol
[✓ B. Alcoholic potassium cyanide]
C. Potassium cyanide
D. Water

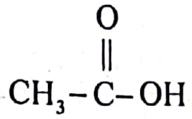
Q.14 **Propanoic acid is produced from ________ on acidic hydrolysis**
A. 1-propanol
B. Isopropyl cyanide
C. n-propyl cyanide
[✓ D. Ethyl cyanide]

Q.15 $CH_3CN + H_2O \xrightarrow{H^+} A \xrightarrow[H_2O]{H^+} CH_3COOH$. **Predict "A" among the following**

A. $CH_3CH_2NH_2$

[✓ B.]

$CH_3-\overset{\overset{O}{\|}}{C}-NH_2$

C.

$NH_2-\overset{\overset{O}{\|}}{C}-NH_2$

D.

$CH_3-\overset{\overset{O}{\|}}{C}-OH$

Q.16 **Potassium carbonate is decomposed by acetic acid and release a gas, the nature of gas is**

A. Basic
B. Neutral
[✓ C. Acidic]
D. Unpredictable

Q.17 **Which group of carboxylic acids is active for reaction with alkali metal carbonates?**

A. H-atom of R group
B. Carbonyl group
[✓ C. H-atom of OH group]
D. Carboxylic group

Q.18 **Which reaction can be used in artificial juices formation with carboxylic acids**

A. Hydration
[✓ B. Esterification]
C. Hydrolysis
D. Salt formation

Q.19 **The addition of ethyl alcohol in protonated acetic acid is**

A. Electrophilic substitution
[✓ B. Nucleophilic addition]
C. Nucleophilic substitution
D. Oxidation

Q.20 **Benzyl alcohol and acetic acid give a compound with ______ fragrance**

A. Banana
B. Pineapple
C. Apricot
[✓ D. Jasmine]

Q.21 **Ammonium acetate converts to acetamide by**

A. Cooling
B. Heating
C. Dehydration
[✓ D. Both B and C]

Q.22 **Which of the following represent acid amide**

A. CH_3COONH_4
B. CH_3COCl
C. CH_3CN
[✓ D. CH_3CONH_2]

Q.23 **Which sequence of groups replace OH of carboxylic acid to halides, esters and amides respectively**

A. OH, X, NH_2
[✓ B. X, OR, NH_2]
C. NH_2, H, X
D. X, OR, NO_2

Q.24 **Which gas release during acid halide formation with the help of thionyl chloride and carboxylic acid**

A. CO_2
B. NO
[✓ C. SO_2]
D. SO_3

Q.25 **During the formation of an acid amide from ethanoic acid, what actually happens**

A. Displacement of the –H from the acid by –Cl
C. Displacement of the –OH from the acid by $-NH_2$
[✓ B. Attachment of $-NH_2$ with the carbonyl oxygen]
D. Displacement of the –H from the acid by $-NH_2$

Q.26 **Carboxylic acids react with active metals (Na, K, Ca and Mg) to form their salt and**

A. H_2O
B. CO_2 only
C. H_2O and CO_2
[✓ D. H_2 gas]

Q.27 Which pair can be used as a reactant for the preparation of acetyl chloride
A. CH_3COOH, HCl
B. CH_3COOH, PCl_5
C. CH_3COOH, $SOCl_2$
[✓ D. Both "B" and "C"]

Q.28 For producing a carboxylic acid derivative. The reaction of nucleophile to carboxyl group is always followed by displacement of
A. –COOH group
[✓ B. –OH group]
C. H atom
D. OR

Q.29 The work of concentrated H_2SO_4 in esterification process is as
[✓ A. Dehydrating agent and catalyst]
B. Hydrolyzing agent
C. Dehydrating agent
D. Catalyst

Q.30 Acetyl chloride is soluble in which solvent
A. Water
B. Ether
C. Acetone
[✓ D. Both 'A' and 'B']

Q.31 Which of the following is not an example of electrophilic substitution reaction
A. Reaction of CH_3COOH with Na
B. Reaction of CH_3COOH with $NaHCO_3$
C. Reaction of CH_3COOH with Na_2CO_3
[✓ D. Reaction of CH_3COOH with PCl_5]

Q.32 Identify reversible reaction among the following
[✓ A. Esterification]
B. Acid Halide formation
C. Acid Amide formation
D. Acid anhydride formation

Q.33 Ethyl butyrate is an ester formed by combination of _______ and butyric acid
[✓ A. Ethyl alcohol]
B. Propyl alcohol
C. Butyl alcohol
D. Methyl alcohol

Q.34 By product produced during hydrolysis of alkane nitrile in basic medium is
[✓ A. NH_3]
B. $(NH_4)_2SO_4$
C. NH_4Cl
D. NH_4NO_3

Q.35 $2CH_3COOH + xCa \longrightarrow Ca(OCOCH_3)_2 + H_2O$. **Calculate value of "x".**
[✓ A. 1]
B. 3
C. 2
D. 4

Q.36 Which of the following carboxylic acid derivative is least reactive?
A. Acyl halide
B. Acid anhydride
[✓ C. Acid amide]
D. Ester

Q.37 The stronger acid among the following is
[✓ A. Cl_3CCOOH]
B. $ClCH_2COOH$
C. $Cl_2CHCOOH$
D. CH_3COOH

Q.38 The strength of the organic acids and chloro substituted acids is measured by pK_a scale such that smaller value of pK_a corresponds to
[✓ A. Stronger acid]
B. Weaker acid
C. Mild acid
D. Very weak acid

Q.39 Organic acids (Carboxylic acids) are considered as
A. Strong acids
[✓ B. Weak acids]
C. Mild acids
D. Mineral acids

Q.40 Identify strongest conjugate base among the following
A. OH^-
B. $RCOO^-$
[✓ C. ^-OR]
D. PhO^-

PAST PAPER QUESTIONS

Q.1 Hydrolysis of cyano group by an aqueous acid results into: MDCAT (2010)
A. Acid amide B. Cyano hydride
[✓ C. Carboxylic acid] D. Formaldehyde

Q.2 Which of the following compounds in the form of aqueous solution will produce CO_2on reaction with sodium carbonate:` MDCAT (2010)
A. $CH_3COOC_2H_5$ B. $C_2H_5COOC_2H_5$
C. $C_2H_5COOCH_3$ [✓ D. $C_2H_5CO\text{-}OH$]

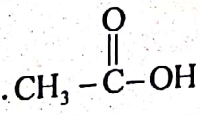
Q.3 $CH_3CN + HCl \rightarrow A + B$ in presence of water in the above reaction A ans B are MDCAT (2011)
A. Acetic acid and acid amide B. Acetic acid and methyl chloride
C. Acetic acid and ammonia [✓ D. Acetic acid and ammonium chloride]

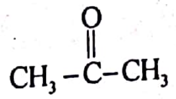
Q.4 Consider the following reaction$CH_3COOH + Mg(metal) \rightarrow$?What product will form MDCAT (2011)
A. Magnesium formate B. Magnesium ion
[✓ C. Magnesium acetate] D. Carboxylate ion

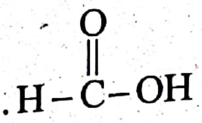
Q.5 $CH_3COOH + PCl_5 \rightarrow$the products of above reaction are MDCAT (2011, 2016)
A. $CH_3COCl + POCl_2 + HCl$ B.$CH_3Cl + POCl_3 + HCl$
[✓ C. $CH_3COCl + POCl_3 + HCl$] D. $CH_3COCl + POCl_3 + H_2$

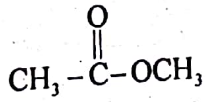
Q.6 The –NH-CO group is called MDCAT (2011)
[✓ A. Amide group] B. Amino group
C. Protein linkage D. Peptide linkage

Q.7 When $CH_3–CH_2–OH$ is oxidized in the presence of $K_2Cr_2O_7$ and H_2SO_4, the product formed is MDCAT (2012)

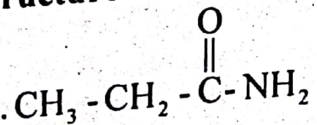
[✓ A.]

$CH_3-\overset{O}{\overset{\|}{C}}-OH$

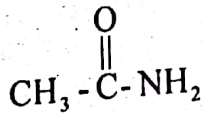
B.

$CH_3-\overset{O}{\overset{\|}{C}}-CH_3$

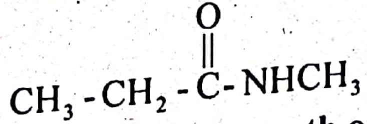
C.

$H-\overset{O}{\overset{\|}{C}}-OH$

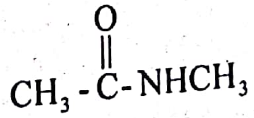
D.

$CH_3-\overset{O}{\overset{\|}{C}}-OCH_3$

Q.8 When ethanoyl chloride reacts with methylamine an amide is formed. What is the structure of it amide formed? MDCAT (2012)

A.

$CH_3-CH_2-\overset{O}{\overset{\|}{C}}-NH_2$

B.

$CH_3-\overset{O}{\overset{\|}{C}}-NH_2$

C.

$CH_3-CH_2-\overset{O}{\overset{\|}{C}}-NHCH_3$

[✓ D.]

$CH_3-\overset{O}{\overset{\|}{C}}-NHCH_3$

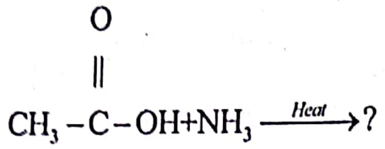
Q.9 Relative acidic strength of alcohol, phenol, water and carboxylic acids is MDCAT (2011, 2013)
A. Carboxylic acid > Alcohol > Phenol > Water
B. Carboxylic acid > Phenol > Water > Alcohol
[✓ C. Phenol > Carboxylic acid > Alcohol > Water]
D. Water >Phenol > Alcohol > Carboxylic acid

Q.10 Methyl cyanides, on boiling with mineral acids or alkalies, yield: MDCAT (2013)
A. Butanoic acid B. Formic acid
[✓ C. Acetic acid] D. Propanoic acid

Q.11 **The formation of ester from acetic acid in presence of acid and ethanol is a:** **MDCAT (2013)**

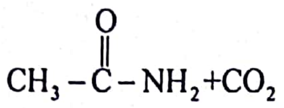
A. Nucleophilic addition reaction
B. Nucleophilic substation reaction
C. Electrophonic substitution reaction
D. Electrophonic addition reactio.

Q.12

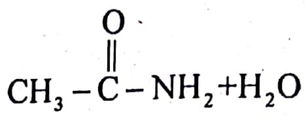


$$CH_3-\overset{\overset{\displaystyle O}{\|}}{C}-OH+NH_3\xrightarrow{Heat}?$$

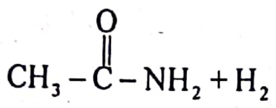
The final products formed are: **MDCAT (2013)**

A. 

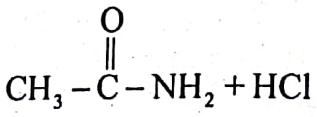
$$CH_3-\overset{\overset{\displaystyle O}{\|}}{C}-NH_2+CO_2$$

B. 

$$CH_3-\overset{\overset{\displaystyle O}{\|}}{C}-NH_2+H_2O$$

C. 

$$CH_3-\overset{\overset{\displaystyle O}{\|}}{C}-NH_2+H_2$$

D. 

$$CH_3-\overset{\overset{\displaystyle O}{\|}}{C}-NH_2+HCl$$

Q.13 **Ethyl butyrate and butyl butanoate are esters with the flavor of** **MDCAT (2014)**

A. Pear
B. Pineapple
C. Banana
D. Apple

"This is actual question given in MDCAT but there should be Ethyl alcohol instead of ethyl butyrate."

Q.14 **Organic compound 'X' and 'Y' both can react with Na-metal to evolve hydrogen gas. 'X' and 'Y' if react with each other form an organic compound 'Z' which gives fruity smell. What types of compounds 'X', 'Y' and 'Z' are?** **MDCAT (2014)**

	X	Y	Z
A.	Alcohol	Ester	Acetic Acid
B.	Alcohol	Ester	Mineral Acid
C.	Alcohol	Acetic Acid	Ester
D.	Alcohol	Mineral Acid	Ester

Q.15 **An organic acid 'z' reacts separately with sodium bicarbonate, sodium hydroxide and sodium carbonate. Which one of the following represent the structure of 'z'** **MDCAT (2015)**

A. $HCOOC_2H_5$
B. CH_3CH_2OH
C. $CH_3-CH=CH_2$
D. H_3C-CH_2-COOH

Q.16 $CH_3COOH+CH_3CH_2OH \rightleftharpoons CH_3COOC_2H_5+H_2O$

Which one of the following will act as a catalyst in above reaction? **MDCAT (2016)**

A. HNO_3
B. Acidified potassium dichromate
C. H_2SO_4
D. $SOCl_2$

Q.17 **Which one of the following reaction of carboxylic acid is reversible?** **MDCAT (2016)**

A. Esterification
B. Reaction with PCl_5
C. Salt formation
D. Reaction with $SOCl_2$

Q.18 'Ka' values of few organic acids are given.

Acid	Ka
CH_3COOH	1.85×10^{-5}
CCl_3COOH	2.3×10^{-2}
$CHCl_2COOH$	5.0×10^{-3}
$CH_2ClCOOH$	1.3×10^{-3}

The order of the acid strength is **MDCAT (2016, 2017)**

[✓ A.] $CCl_3COOH > CHCl_2COOH > CH_2ClCOOH > CH_3COOH$
B. $CH_3COOH > CHCl_2COOH > CCl_3COOH > CH_2ClCOOH$
C. $CHCl_2COOH > CH_3COOH > CCl_3COOH > CH_2ClCOOH$
D. $CCl_3COOH > CH_3COOH > CHCl_2COOH > CH_2ClCOOH$

Q.19 Compounds having —C ≡ N group are called **MDCAT (2017)**

A. Cyano compounds B. Nitro compounds
C. Carbon nitrogen molecules [✓ D.] Nitriles

Q.20 Final product of hydrolysis of nitrile yield: **MDCAT (2017)**

A. Ketone B. Alcohol
C. Aldehyde [✓ D.] Carboxylic acid

Q.21 During esterification, the bond from alcohol that breaks is between: **MDCAT (2017)**

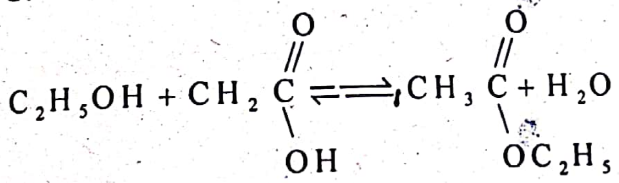
A. Carbon and Oxygen B. Carbon and carbon
[✓ C.] Oxygen and hydrogen D. None of these

Q.22 Identify the product X in the following reaction: **MDCAT (2017)**

$$CH_3COOH + PCl_5 \xrightarrow{Yields} X + POCl_3 + HCl$$

[✓ A.] CH_3COCl B. $CH_3COCH_2Cl_2$
C. CH_3COCl_2 D. CH_2COCl_2

Q.23



$$C_2H_5OH + CH_3\overset{O}{\overset{\|}{C}}-OH \rightleftharpoons CH_3\overset{O}{\overset{\|}{C}}-OC_2H_5 + H_2O$$

Which of the following catalyst is used in the above reaction? **MDCAT (2018)**

A. Pt B. Ni
C. Pumice stone [✓ D.] Conc. H_2SO_4

Q.24 Which product is formed by the reaction of carboxylic acid with alcohol? **MDCAT (2018)**

[✓ A.] Ester B. Aldehyde
C. Alkane D. Ether

Q.25 Which one will be act as a strong acid **MDCAT (2018)**

A. Dichloroethanoic acid B. Ethanoic acid
[✓ C.] Trichloethanoic acid D. Chloroethanoic acid

Q.26 Acetyl chloride (Ethanoyl chloride) is used in the synthesis of organic compounds. It is prepared by treating acetic acid with **SET (2019)**

[✓ A.] $SOCl_2$ B. HCl
C. CH_3Cl D. $ClNH_2$

Q.27 What will be the outcome of reaction of methanol with ethanoic acid in the presence of concentrated sulphuric acid? SET (2019)

A. Propanone is formed
B. Propanoic acid formed
[✓ C. Methyl ethanoate is formed]
D. Propanol is formed

Q.28 Which one of the following compounds can exist in the form of cyclic dimers? SET (2019)

A. Benzene
B. Acetals
C. Ozonide
[✓ D. A carboxylic acid]

Q.29 Reagent used to reduce a carboxylic acid to an alkance is NUMS (2019)

A. Ni/H_2
[✓ B. $NaBH_4$]
C. P/HI
D. $LiAlH_4$

Q.30 Which of the following is not a fatty acid? NUMS (2019)

[✓ A. Phenyl acetic acid]
B. Stearic acid
C. Palmitic acid
D. Oleic acid

Q.31 Select the correct order of the acids strength? ETEA (2016)

A. $CH_3COOH > CHCl_2COOH > CH_2ClCOOH$
[✓ B. $CHCl_2COOH > CH_2ClCOOH > CH_3COOH$]
C. $CH_3COOH > CHCl_2COOH > CH_2ClCOOH$
D. $CHCl_2COOH > CH_2COOH > CH_2ClCOOH$

Q.32 Which compound shows the highest boiling point? ETEA (2019)

[✓ A. CH_3COOH]
B. C_2H_5OH
C. $C_2H_5-0C_2H_5$
D. $(CH_3CH_2)_3N$

Q.33 Which one is more reactive? ETEA (2019)

A. Ester
[✓ B. Acid halide]
C. Amide
D. Acid anhydride

Q.34 Nitriles (RCN) on hydrolysis in the presence of a mineral acid yield: MDCAT (2019)

A. Ethers
B. Aldehydes
C. Alcohols
[✓ D. Carboxylic acids]

Q.35 Carboxylic acids can be reduced into corresponding alcohols. Which of the following reagent can be used for this purpose? MDCAT (2019)

A. $K_2Cr_2O_4$
[✓ B. $LiAlH_4$]
C. H_2SO_4
D. $KMnO_4$

Q.36 Which of the following reagent is required for preparation of acyl chloride (CH_3COCl) from ethanoic acid? MDCAT (2019)

A. HCl
[✓ B. PCl_5]
C. CH_3Cl
D. $POCl_3$

Q.37 Which balance chemical equation show the formation of ethanoyl chloride using thionyl chloride? MDCAT (2019)

A. $CH_3CH_2COOH + 2SOCl \rightarrow CH_3CH_2COCl + SO_2 + HCl$
[✓ B. $CH_3COOH + SOCl_2 \rightarrow CH_3COCl + SO_2 + HCl$]
C. $HCOOH + SOCl_2 \rightarrow HCOCl + SO_2 + HCl$
D. $CH_3CH_2COOH + 2SOCl \rightarrow CH_3CH_2COCl + SO_3 + HCl$

Q.38 **Which of the following is the strongest acid?** NMDCAT (2020)
A. Propanoic acid
B. Flouroethanoic acid
[✓ C. Trichloroethanoic acid]
D. Nitroethanoic acid

Q.39 **Hydrolysis of acyl chloride results in the formation of** NMDCAT (2020)
A. Acid anhydride
[✓ B. Carboxylic acid]
C. Amides
D. Esters

Q.40 **The exact reactivity order for carboxylic acid derivatives is** NMDCAT (2020)
A. Anhydride > Acyl chloride > Ester
B. Ester > Anhydride > Acyl chloride
C. Amide > Acyl chloride > Ester
[✓ D. Acyl chloride > Anhydride > Ester]

ANSWER KEY

1	C	11	D	21	D	31	D
2	D	12	A	22	D	32	A
3	D	13	B	23	B	33	A
4	D	14	D	24	C	34	A
5	B	15	B	25	B	35	A
6	A	16	C	26	D	36	C
7	D	17	C	27	D	37	A
8	A	18	B	28	B	38	A
9	A	19	B	29	A	39	B
10	A	20	D	30	D	40	C

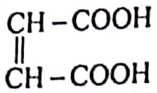
PAST PAPERS QUESTIONS

1	C	6	A	11	B	16	C	21	C	26	A	31	B	36	B
2	D	7	A	12	B	17	A	22	A	27	C	32	A	37	B
3	D	8	D	13	B	18	A	23	D	28	D	33	B	38	C
4	C	9	C	14	B	19	D	24	A	29	B	34	D	39	B
5	C	10	C	15	D	20	D	25	C	30	A	35	B	40	D

EXPLANATORY NOTES

Q.1 The general formula of carboxylic acid is $C_nH_{2n}O_2$

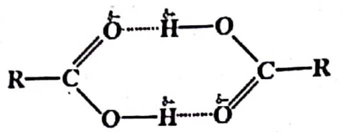
Q.2



$$\begin{array}{l} CH-COOH \\ \| \\ CH-COOH \end{array}$$

have double bond and have open chain structure

Q.3

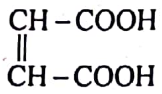


Dimer of a carboxylic acid

Q.4 The first three aliphatic acids, formic acid, acetic acid, and propionic acid are colourless liquids and have a pungent smell. The next three acids C-4 to C-6 are colourless liquids with somewhat unpleasant smell.

Q.5 The pure acid freezes to an ice like solid at 17°C. Therefore, it is also called **glacial acetic acid.**

Q.6



$$\begin{array}{l} CH-COOH \\ \| \\ CH-COOH \end{array}$$

have double bond and have open chain structure. Hence its is unsaturated aliphatic acid

Q.7 Carbolic acid = Phenol

Carbonic acid = H_2CO_3

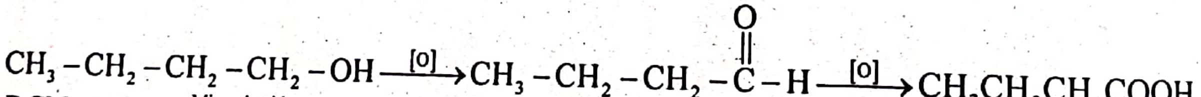
Picric acid = 2,4,6 – Trinitrophenol

Palmitic acid = Carboxylic acid

Q.8 Aliphatic monocarboxylic acid is called fatty acid. Fats on hydrolysis give saturated fatty acids. Succinic acid is a dicarboxylic acid so it is not a fatly acid

Q.9 2–Methyl –2– propanol is tertiary alcohol. So it cannot be oxidized to carboxylic acid because it does not contain α-H. Under same conditions it show elimination and give alkene

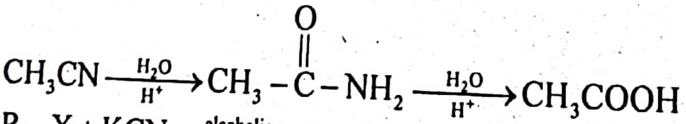
Q.10



$$CH_3-CH_2-CH_2-CH_2-OH \xrightarrow{[0]} CH_3-CH_2-CH_2-\overset{\overset{\displaystyle O}{\|}}{C}-H \xrightarrow{[0]} CH_3CH_2CH_2COOH$$

Q.11 $RCN + H_2O \xrightarrow[HCl]{\text{Mineral acid}} RCOOH + NH_4Cl$

Q.12

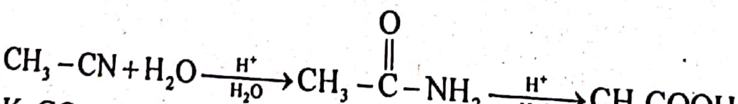


$$CH_3CN \xrightarrow[H^+]{H_2O} CH_3-\overset{\overset{\displaystyle O}{\|}}{C}-NH_2 \xrightarrow[H^+]{H_2O} CH_3COOH$$

Q.13 $R-X+KCN \xrightarrow{\text{alcoholic}} R-CN+KX$

Q.14 $C_2H_5-CN \xrightarrow[H+]{H_2O} CH_3CH_2COOH$

Q.15



$$CH_3-CN+H_2O \xrightarrow[H_2O]{H^+} CH_3-\overset{\overset{\displaystyle O}{\|}}{C}-NH_2 \xrightarrow[H_2O]{H^+} CH_3COOH$$

Q.16 $K_2CO_3 + 2CH_3COOH \longrightarrow 2CH_3COOK + CO_2 + H_2O$

CO_2 is evolved which is acidic in nature

Q.17 Reaction with carboxylic acid and carbonates are example of E^+– substitution

$Na + CH_3COOH \longrightarrow CH_3COONa + \frac{1}{2}H_2$, So, O – H bond break

Q.18 Artificial flavours are derived from esters and reaction between acid and alcohol is called esterification

Q.19 Esterification is an example of Nucleophilic substitution reaction. During the mechanism when alcohol attacks through lone pair of O-atom on double bonded carbon of carboxyl group this step is called nucleophillic addition reaction

Q.20 $CH_3COOH + C_6H_5CH_2OH \xrightleftharpoons{H^+} CH_3COOCH_2C_6H_5 + H_2O$ Having jasmine fragrance.

Q.21 $CH_3COONH_4 \xrightarrow{\Delta} CH_3-CO-NH_2 + H_2O$, It is a heating and dehydration reaction

Q.22 $CH_3-CO-NH_2 \longrightarrow$ acid amide

Q.23 Acid halides $(-OH \text{ by} - X)$, Esters $(-OH \text{ by} - OR)$, Amides $(-OH \text{ by} - NH_2)$

Q.24 $CH_3COOH+SOCl_2 \longrightarrow CH_3COCl+H_2O+SO_2$

Q.25 $-OH$ replaced by $-NH_2$

Q.26 RCOOH + active metal $\longrightarrow$ Salt + H_2

Q.27 $CH_3COOH+SOCl_2 \longrightarrow CH_3COCl+H_2O+SO_2$

$CH_3COOH + PCl_5 \longrightarrow CH_3COCl + POCl_3 + HCl$

$3CH_3COOH + PCl_3 \longrightarrow 3CH_3COCl + H_3PO_3$

Q.28 For Nucleophilic substitution reaction of carboxylic acid

$\longrightarrow C-O$ bond breaks

$\longrightarrow -OH$ replace by $-OR$, $-X$, $RCOO-$ and NH_2

Q.29 Mineral acid act as catalyst and dehydrating agent during esterification

Q.30 Acetyl chloride is polar and will dissolve more in polar solvent

Q.31 $CH_3COOH + PCl_5 \longrightarrow CH_3-CO-Cl + POCl_3 + HCl$, In this reaction C – O bond of carboxylic a

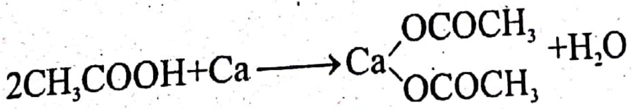
Q.32 $CH_3COOH + C_6H_5CH_2OH \xrightleftharpoons{H^+} CH_3COOCH_2C_6H_5 + H_2O$

Q.33 $C_2H_5-OH + HO-CO-CH_2-CH_2-CH_3 \longrightarrow C_2H_5-O-CO-CH_2-CH_2-CH_3 + H_2O$

Ethyl Butyrate

Q.34 $R-CN+H_2O \xrightarrow{OH^-} RCOOH+NH_3$

Q.35



$$2CH_3COOH+Ca \longrightarrow Ca\begin{matrix}\diagup OCOCH_3\\ \diagdown OCOCH_3\end{matrix} + H_2O$$

Only one mole of Ca is needed

Q.36 Acid amides are least reactive (Acid halides > Acid anhydride > Ester > Amide)

Q.37 Halogens are electron withdrawing group. Greater the number of halogens, more the electron withdrawing effect, strong will be acid.

Q.38 $pK_a \propto \frac{1}{\text{acidity}}$

Q.39 Carboxylic are weak acid

Q.40

$OH^{-1} + H^+ \longrightarrow H-OH$

$^-OR + H^+ \longrightarrow R-OH$

$RCOO^- + H^+ \longrightarrow RCOOH$

$PhO^- + H^+ \longrightarrow PhOH$

Among these conjugate acids, alcohol is the weakest acid. If acid is weakest, strongest will be conjugate base

Topic-18

EXPLANATORY NOTES

(PAST PAPER QUESTIONS)

Q.1 Acidic hydrolysis of alkyl cyanides gives carboxylic acid as a product

$$R\text{-}C\equiv N+H_2O \xrightleftharpoons{HCl} RCOOH+NH_4Cl$$

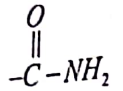
Q.2 C_2H_5COOH (carboxylic acid) can produce CO_2 with metal carbonates and bicarbonates

$$2C_2H_5COOH+Na_2CO_3 \longrightarrow 2C_2H_5COONa+H_2O+CO_2$$

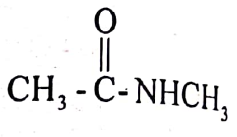
Q.3 $CH_3\text{-}C\equiv N+H_2O \xrightleftharpoons{HCl} CH_3COOH+NH_4Cl$

Q.4 The reaction between acetic acid and Mg metal will produce magnesium acetate$[(CH_3COO)_2Mg]$

Q.5 $CH_3COOH + PCl_5 \rightarrow CH_3COCl + POCl_3 + HCl$

Q.6 
$-\overset{O}{\overset{\|}{C}}-NH_2$ is called as amide group

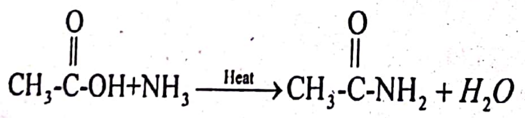
Q.7 When $CH_3\text{–}CH_2\text{–}OH$ is oxidized in the presence of $K_2Cr_2O_7$ and H_2SO_4, CH_3COOH as the product is formed

Q.8 When ethanoyl chloride reacts with methylamine an amide is formed. 
$CH_3-\overset{O}{\overset{\|}{C}}-NHCH_3$ is the structure of product formed.

Q.9 Carboxylic acid > Phenol > Water > Alcohol is the correct order of relative strength of given substances due to stabilities of conjugate bases.

Q.10 Methyl cyanides, on boiling with mineral acids or alkalies, yield acetic acid or salt

Q.11 The formation of ester from acetic acid in presence of acid ethanol is nucleophillic substitution reaction.

Q.12 
$$CH_3\text{-}\overset{O}{\overset{\|}{C}}\text{-}OH+NH_3 \xrightarrow{Heat} CH_3\text{-}\overset{O}{\overset{\|}{C}}\text{-}NH_2+H_2O$$

Q.13 Ethyl butyrate and butyl butanoate are esters with the flavor of pineapple

Q.14 X = Alcohol, Y = Acetic acid and Z = Ester, alcohol and acid release hydrogen gas with sodium metal and both react with each other to form ester giving fruity smell.

Q.15 $CH_3\text{-}CH_2\text{-}COOH$ is a stronger acid among all given substances so can react with NaOH, Na_2CO_3 and specially $NaHCO_3$.

Q.16 $CH_3COOH+CH_3CH_2OH \xrightleftharpoons{H_2SO_4} CH_3COOC_2H_5+H_2O$ in this reaction H_2SO_4 is used as a catalyst

Q.17 Esterification is the reversible reaction among the derivatives of carboxylic acid

Q.18 $CCl_3COOH > CHCl_2COOH > CH_2ClCOOH > CH_3COOH$ is the correct order of acidic strength, greater the number of electron withdrawing groups stable the conjugate base hence stronger the acid

Q.19 Compounds having $-C\equiv N$ group are called nitrile

Q.20 Final product of hydrolysis of nitrile yield carboxylic acid

$$R\text{-}C\equiv N+H_2O\xrightleftharpoons{HCl}RCOOH+NH_4Cl$$

Q.21 During esterification, bond between oxygen and hydrogen is broken in case of alcohols

Q.22 $CH_3COOH + PCl_5 \xrightarrow{Yields} X + POCl_3 + HCl$, here X is CH_3COCl

Q.23 Conc. Sulphuric acid is used as a catalyst in esterification

Q.24 Ester is formed by the reaction of carboxylic acid with alcohol

$$CH_3COOH+CH_3CH_2OH\xrightleftharpoons{H_2SO_4}CH_3COOC_2H_5+H_2O$$

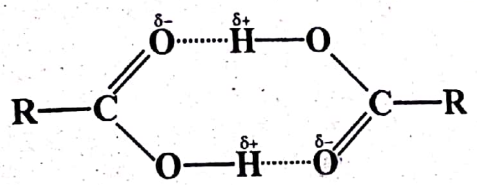
Q.25 Trichloroacetic acid is the strongest among all

$$CCl_3COOH > CHCl_2COOH > CH_2ClCOOH > CH_3COOH$$

Q.26 Acetyl chloride (ethanoyl chloride) is prepared by reacting acetic acid with $SOCl_2$

Q.27 Methyl ethanoate is formed when methanol reacts with acetic acid

Q.28 Carboxylic acid can form cyclic dimer by hydrogen bonding



Dimer of a carboxylic acid

Q.29 Carboxylic acids undergo complete reduction to form alkanes by using HI/P(Red).

Q.30 Aliphatic mono-carboxylic acids are known as fatty acids while Phenyl acetic acid is aromatic carboxylic acid.

Q.31 Given order is the correct $CHCl_2COOH > CH_2ClCOOH > CH_3COOH$, greater the number of electron withdrawing groups stable the conjugate base hence stronger the acid

Q.32 Acetic acid is the stronger than all given due to stronger hydrogen bonding.

Q.33 The correct order is Acid halide > Acid anhydride > Ester > Amides

Q.34 Nitriles (RCN) on hydrolysis in the presence of a mineral acid yield carboxylic acid.

$$R-C\equiv N+H_2O\xrightleftharpoons{HCl}RCOOH+NH_4Cl$$

Q.35 Carboxylic acid can be partially reduced to primary alcohol by using $LiAlH_4$.

Q.36 PCl_5 is required for preparation of acyl chloride (CH_3COCl) from ethanoic acid.

Q.37 $CH_3COOH+SOCl_2\rightarrow CH_3COCl+SO_2+HCl$ is the balanced equation.

Q.38 Trichloroacetic acid is the strongest acid due to stronger electron withdrawing effect.

Q.39 Hydrolysis of acyl chloride results in the formation of carboxylic acid.

Q.40 The correct order is Acid halide > Acid anhydride > Ester.

Topic 19

MACROMOLECULES

PRACTICE EXERCISE

Q.1 **Zigzag and regular coiling of polypeptide linkage forms**
A. Primary structure
[✓ B. Secondary structure]
C. Tertiary structure
D. Quaternary structure

Q.2 **The hydrogen bond in secondary structure of protein is present between**
[✓ A. O – H]
B. N – H
C. C – H
D. F – H

Q.3 **Primary structure of proteins shows**
A. Folding
[✓ B. Sequence of amino acids]
C. Coiling
D. It is due to hydrogen bonding

Q.4 **Which of the following statement is false about protein**
A. Peptide bond is a covalent bond
B. It is a polyamide
C. It contain different sequence of amino acids in different proteins
[✓ D. Primary structure is due to hydrogen bonding]

Q.5 **Which one of the following structure of protein is the direct consequence of hydrogen bonding**
A. Primary
B. Tertiary
[✓ C. Secondary]
D. Quaternary

Q.6 **Primary structure of protein arises due to which force**
A. Hydrogen bonding
[✓ B. Covalent bond]
C. Debye forces
D. Dipole-Dipole forces

Q.7 **Secondary structure of protein includes**
A. α-helix
[✓ B. Both A. and C.]
C. β-sheets
D. 3-dimensioal folding

Q.8 **Which is true about primary structure**
A. Result of replication
B. Result of termination
C. Result of duplication
[✓ D. Result of translation]

Q.9 **Which is not present in an α-helix**
A. H–Bond
[✓ B. Disulphide linkage]
C. Covalent bond
D. Amino acids

Q.10 **Which carbon of amino acids bond to nitrogen of another in peptide linkage**
A. α-Carbon
B. β Carbon
C. Side chain carbon
[✓ D. Carbonyl carbon]

Q.11 **All proteins yield __________ upon complete hydrolysis.**
A. Nitrogen
[✓ B. Amino acids]
C. Carbon and hydrogen
D. Sulphur

Q.12 **Protein attached to some non protein group is called**
A. Derived protein
B. Sample protein
C. Proteoses
[✓ D. Conjugated protein]

Q.13 **Regular coiling or zigzagging of polypeptide through hydrogen bonding is its.**
A. Quaternary structure
[✓ B. Secondary structure]
C. Tertiary structure
D. Primary structure

Q.14 **What common name can be given to lipids, proteins, carbohydrates and nucleic acid polymers**
A. Organic polymers
B. Inorganic polymers
[✓ C. Biopolymers]
D. Synthetic polymers

Q.15 **Which one of the following polymers has peptide linkage in it?**
A. Terylene
[✓ B. Nylon 6,6]
C. Protein
D. Urea

Q.16 Which factor cannot denature the protein

A. pH change
B. Increase of temperature
C. Oxidizing condition
[✓ D. Dissolving in H_2O]

Q.17 Which of the following elements is not present in all proteins

A. Carbon
B. Hydrogen
[✓ C. Sulphur]
D. Nitrogen

Q.18 Enzymes that catalyze the transfer of groups within molecule are called

[✓ A. Isomerases]
B. Lyases
C. Transferases
D. Ligases

Q.19 Enzyme used for the treatment of blood cancer in children is

A. Cellulose
B. Urease
[✓ C. L-asperginase]
D. Lactic dehydrogenase

Q.20 Enzymes from the same organism which catalyze same reaction but are chemically and physically distinct from each other are called

A. Oxidoreductases
B. Hydrolases
[✓ C. Isoenzymes]
D. Isomerases

Q.21 Rate of enzymatic reaction is directly proportional to the concentration of

A. Enzyme
[✓ B. Substrate]
C. Enzyme and substrate
D. Enzyme and product

Q.22 The rate of reaction is directly proportional to

A. $[\text{Enzyme}]^2$
B. $[\text{Enzyme}]^3$
C. [Enzyme]
[✓ D. $[\sqrt{[\text{Enzyme}]}]$]

Q.23 The substrate binds with the enzyme at

A. Polar site
B. Cationic site
[✓ C. Active site]
D. Anionic site

Q.24 Many enzymes contain a protein part and a non-protein part, the non-protein part is called________

A. Apoenzyme
B. Coenzyme
C. Cofactors
[✓ D. Both B and C]

Q.25 The group of compounds that is primarily responsible for building of body of an animal and its maintenance is called

A. Vitamin
B. Carbohydrate
C. Lipids
[✓ D. Proteins]

Q.26 Which enzyme is used to catalyze the addition of ammonia, water or carbon dioxide to double bond

A. Phospho-transferase
B. Phospho-glyceromutases
[✓ C. Fumarase]
D. Succinic thiokinase

Q.27 The activator for chrome oxidase is

[✓ A. Fe^{+2}]
B. Zn^{+2}
C. Mg^{+2}
D. Fe^{+3}

Q.28 Thrombin is used

A. For treatment of cancer
[✓ B. Locally to stop bleeding]
C. To diagnose heart disease
D. For treatment of rickets

Q.29 For the treatment of blood cancer in children ____enzyme has proved very useful

A. Thrombin
B. LDH-1
[✓ C. L-asparaginase]
D. Alkaline phosphatase

Q.30 Protein part of the enzyme is called

[✓ A. Apoenzyme]
B. Coenzyme
C. Cofactors
D. Holoenzyme

PAST PAPER QUESTIONS

Q.1 Collagen and albumin are: MDCAT (2010)

A. Derived proteins
B. Polyamide
[✓ Simple proteins]
D. Polysaccharide

Q.2 A polymer in which the number of amino acid residue is greater than 100 or the molecular mass is greater than 10,000 is called MDCAT (2011)

[✓ Protein]
B. Polypeptide
C. Dipeptide
D. Tripeptide

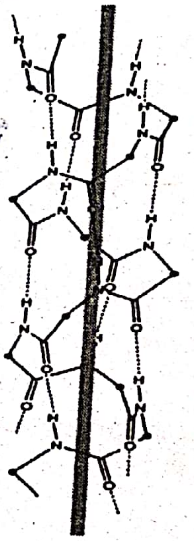
Q.3 Macromolecules are described as large moelucles built up from small repeating units called MDCAT (2012)

[✓ Monomers]
B. Metamers
C. Isomers
D. Tautomers

Q.4 Phosphoprotein comes under the type of proteins MDCAT (2017)

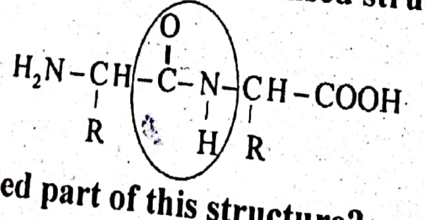
A. Simple protein
B. Derived protein
[✓ Conjugated]
D. Both A & B

Q.5 The stability in the following structure in due to the MDCAT (2018)



A. Disulfide bridges
B. Weak vander Waal's forces
C. Presence of unpaired electron in the structure
[✓ Hydrogen bonding between NH group of one peptide with another peptide]

Q.6 Amino acids react with each other such that –COOH group of one amino acid reacts with the another among acid to give a condensed structure as shown below



$$H_2N-\underset{R}{\underset{|}{CH}}-\overset{O}{\overset{\|}{C}}-\underset{H}{\underset{|}{N}}-\underset{R}{\underset{|}{CH}}-COOH$$

What is the name of circled part of this structure? MDCAT (2018)

[✓ Peptide linkage]
B. Azide linkage
C. Ester linkage
D. Carbide linkage

Q.7 Role of a catalyst in a chemical reaction is to MDCAT (2018)

[✓ Increase rate of a reaction]
B. Decrease rate of a reaction
C. Decrease yield of a reaction
D. Increase yield of product

Q.8 **Glucose is converted into ethanol by the enzyme present in the yeast:MDCAT (2010)**

A. Urease [✓ B. Zymase]
C.Invertase D. Sucrase

Q.9 **The proteins which give an amino acid and non-protein group on hydrolysis are known as:** SET (2019)

A. Derived protein B. Albumins
C. Conjugated simple protein [✓ D. Conjugated protein]

Q.10 **The enzyme which is found in saliva, accelerates the conversion of starch into sugar is;** ETEA (2019)

A. Pepsin B. Thrombin
[✓ C. Ptyalin] D. Fumarase

Q.11 **Which of the following bond is responsible for joining the amino acids in proteins?** MDCAT (2019)

A. Metallic Bond B. Di sulfide bond
[✓ C. Peptide Bond] D. Ionic Bond

Q.12 **Based on the physico-chemical properties, proteins may be classified into the following types:** NMDCAT (2020)

A. Simple proteins B. Compound proteins
C. Derived proteins [✓ D. All of the above]

Q.13 **Based on function, thyroxin can be classified as:** NMDCAT (2020)

[✓ A. Hormonal protein] B. Structural protein
C. Transport protein D. Genetic protein

Q.14 **L-Asparaginase enzymes has been used for the treatment of:** NMDCAT (2020)

A. Jaundice [✓ B. Blood cancer]
C. Rickets D. Heat disease

ANSWER KEY

1	B	11	B	21	B
2	A	12	D	22	D
3	B	13	B	23	C
4	D	14	C	24	D
5	C	15	B	25	D
6	B	16	D	26	C
7	B	17	C	27	A
8	D	18	A	28	B
9	B	19	C	29	C
10	D	20	C	30	A

PAST PAPERS QUESTIONS

1	C	6	A	11	C
2	A	7	A	12	D
3	A	8	B	13	A
4	C	9	D	14	B
5	D	10	C		

EXPLANATORY NOTES

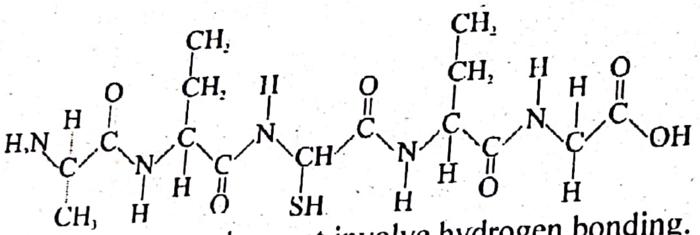
Q.1 The secondary structure of a protein is a regular coiling or zigzagging of polypeptide chains caused by hydrogen bonding between NH and C = O groups of amino acids near each other in the chains.

Q.2

$\rangle C = \overset{\delta-}{O} --- \overset{\delta+}{H} - NH$

Q.3 A linear sequence of amino acids in a chain is referred as primary structure.

Q.4

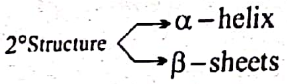


Primary structure does not involve hydrogen bonding.

Q.5 α-Helix and β-sheets (secondary structure) are due to hydrogen bonding.

Q.6 Amino acids are joined in primary structure by covalent bond,.

Q.7



Q.8 Formation of polypeptide chain from RNA is called translation.

Q.9 2° structure is due to hydrogen bonding.

Q.10 Peptide linkage is between $-COOH$ and $-NH_2$ groups.

Q.11 High molecular weight organic molecules which yield amino acids upon complete hydrolysis are called proteins. They are the **polymers of amino acids.**

Q.12 In these molecules the protein is attached or conjugated to some non-protein groups which are called **prosthetic groups.**

Example: Phospho-proteins are conjugated with phosphoric acid. Lipoproteins are conjugated with lipid substances like lecithin, cholesterol and fatty acids.

Q.13 The secondary structure of a protein is a regular coiling or zigzagging of polypeptide chains caused by hydrogen bonding between NH and C = O groups of amino acids near each other in the chains.

Q.14 Most biologically important substances are organic compounds (Biopolymers) built up from skeleton of carbon atoms. Many of them are very large molecules and most of these are polymers. The four major classes of organic compounds in living cells are carbohydrates, lipids, proteins and nucleic acids.

Q.15 To describe the structure of a protein in an organism it is necessary to specify the three-dimensional shape that the polypeptide chain assumes.

Q.16 The deformation or disruption of protein structure under specific conditions is called denaturation of proteins. Denaturation occurs by

- Heat change
- pH change

Under strong oxidizing or reducing conditions.

Q.17 All proteins contain the elements carbon, hydrogen, oxygen and nitrogen except sulphur.

Q.18 Isomerases

These enzymes catalyze the transfer of groups within molecules to yield isomeric forms of the substrate, for example phospho-glyceromutases.

Q.19 L-asparaginase has proved very useful in the treatment of blood cancer in children.

Q.20 Isoenzymes

- These are the enzymes from the same organisms which catalyze the same reaction but are chemically and physically distinct from each other.

Example: α-amylase β-amylase.

Q.21 The rate of an enzymatic reaction is directly proportional to the concentration of the substrate.

Q.22 The rate of reaction is also directly proportional to the square root of the concentration of enzyme.

Q.23 Each enzyme molecule possesses a region known as **active site** and the substrate binds itself with this active site.

Q.24 The protein component of the enzyme is called **apo-enzyme** and the non-protein component is called the **co-enzyme**. The co-enzyme is also known as co-factor.

Q.25 The group of compounds that is primarily responsible for building of body of an animal and its maintenance is called protein.

Q.26 **Lyases**

These enzymes catalyze the addition of ammonia, water or carbon dioxide to double bonds or removal of these to form double bond.

Example: The conversion of fumaric acid to maleic acid in the presence of fumarase enzyme.

Q.27

- Important inorganic co-factors alongwith their respective enzymes include
- Fe^{2}+ (chrome oxidase)
- Zn^{2}+ (carbonic anhydrase)
- Mg^{2}+ (glucose 6-phosphatase), etc.

Many enzymes contain vitamins as their co-factors.

Q.28

Alkaline phosphatase is raised in rickets obstructive jaundice.

(ii) Lactic dehydrogenase or LDH-1 is raised in heart diseases.

- Many enzymes have proved very useful as drugs.

Example: Thrombin is used locally to stop bleeding.

- Many enzymes are used for cancer treatment.

Example: L-asparaginase has proved very useful in the treatment of blood cancer in children.

Q.29 L-asparaginase has proved very useful in the treatment of blood cancer in children.

Q.30 The protein component of the enzyme is called **apo-enzyme** and the non-protein component is called the **co-enzyme**. The co-enzyme is also known as co-factor.

Topic-19

EXPLANATORY NOTES

(PAST PAPER QUESTIONS)

Q.1 Collagen and albumin are simple proteins

Q.2 A polymer in which the number of amino acid residue is greater than 100 or the molecular mass is greater than 10,000 is called proteins

Q.3 Macromolecules are described as large molecules built up from small repeating units called monomers

Q.4 Phosphoprotein comes under the type of conjugated proteins

Q.5 The stability in the given structure in due to the hydrogen bonding between NH group of one peptide and carbonyl (C = O) of another peptide residue

Q.6 The bond between COOH and NH_2 is called peptide bond

Q.7 Catalyst is used to increase the rate of a chemical reaction

Q.8 Zymase enzyme is used to convert glucose into ethanol

Q.9 The proteins which give an amino acid and non-protein group on hydrolysis are known as conjugated protein

Q.10 Ptyalin is found in saliva to accelerates the conversion of starch into sugar

Q.11 Peptide bond is responsible for joining the amino acids in proteins

Q.12 Types of proteins on the basis of physico-chemical properties are three:

- Simple proteins
- Compound proteins
- Derived proteins

Q.13 Thyroxin can be classified as hormonal protein

Q.14 L-Asparaginase enzymes has been used for the treatment of blood cancer

1 UNIT

INTRODUCTION TO FUNDAMENTAL CONCEPTS OF CHEMISTRY

SELF ASSESSMENT TEST

Q.1 **Mass of an atom of C is**

A. $\frac{12}{N_A}$g
B. 12amu
C. $12 \times 1.661 \times 10^{-24}$g
[✓ D. All of these]

Q.2 **1gram molecule refers to amount in grams**

A. Equivalent to 1 mole of an atom
[✓ B. Equivalent to 1 mole of a molecule]
C. Equivalent to 1 mole of an ionic species
D. Of an ionic compound

Q.3 **1gram formula refers to:**

A. Amount in grams equivalent to 1 mole of a atom
B. Amount in grams equivalent to 1 mole of a covalent compound
[✓ C. Amount in grams equivalent to 1 mole of a ionic compound]
D. Amount in grams equivalent to 1 mole of an ion

Q.4 **One mole of SO_2 contains**

A. 6.022×10^{23} atoms of oxygen
B. 18.1×10^{23} molecules of SO_2
[✓ C. 6.022×10^{23} atoms of sulfur]
D. 4 g molecule of SO_2

Q.5 **The mass of 1 mole of magnesium atoms is 24g. What is the mass of one magnesium atom in grams**

A. 6.02×10^{23}
B. 6.02×10^{-23}
[✓ C. 3.99×10^{-23}]
D. 3.99×10^{23}

Q.6 **The approximate number of molecules present in 3g of H_2O is**

A. 3×10^{23}
B. 1×10^{23}
[✓ C. $3 \times 6.01 \times 10^{23}$]
D. 2×10^{23}

Q.7 **The largest number of molecules are present in**

[✓ A. 3.6 of H_2O]
B. 4.6 g of C_2H_5OH
C. 2.8 g of CO
D. 5.4 g of N_2O_5

Q.8 **40g of calcium is**

A. 1gram of Ca
B. 1atom of Ca
[✓ C. 1gram atom of Ca]
D. 1gram ion of Ca

Q.9 **How many atoms of carbon are present in 34.2g of sucrose**

A. 6.02×10^{22}
B. 3.6×10^{23}
[✓ C. 7.2×10^{23}]
D. 1.2×10^{22}

Q.10 **If a ring is made up of 6g diamond, then number of atoms present in it are**

A. 6.02×10^{23}
B. 1.5×10^{23}
[✓ C. 3.01×10^{23}]
D. 7.5×10^{22}

Q.11 **Moles of protons in 20g of SO_3**

[✓ A. 10]
B. 20
C. 40
D. 80

Q.12 **The mass of 10^{-3} moles of $MgSO_4$ is**

[✓ A. 0.12g]
B. 2.12g
C. 1.12g
D. 4.12g

Q.13 **Which of the following contains same number of atoms as 12g of Mg**
A. 12g Carbon
[✓ B. 10g Neon]
C. 5g Neon
D. 3g Carbon

Q.14 **Equal volumes of CO and N_2 are taken in identical conditions, The correct relationship between masses of two gases is**
A. CO < N_2
[✓ B. CO = N_2]
C. N_2 < CO
D. All of these

Q.15 **The largest number of molecules are present in**
A. 44g CO_2
B. 98g H_2SO_4
[✓ C. 36g H_2O]
D. 180g of $C_6H_{12}O_6$

Q.16 **The Avogadro's number of atom or molecules or formula units of a substance is called its**
A. Molecular weight
[✓ B. Mole]
C. Molecular mass
D. None of these

Q.17 **Which of the following quantity is not 1mole**
A. 1g atom of an element
B. 1g formula of an ionic compound
[✓ C. 1 atomic mass unit]
D. 1g molecule of covalent compound

Q.18 **18.02g of H_2O**
A. 1 mole of hydrogen atoms
B. 6.022×10^{23} moles of H_2O
C. ½ mole of oxygen atoms
[✓ D. 6.022×10^{23} molecules of H_2O]

Q.19 **A unit which represents 6.02×10^{23} particles is called**
A. Mole
B. 1 gram molecule nitrogen
C. 1 gram ionic mass
[✓ D. All of these]

Q.20 **% of nitrogen in urea (NH_2CONH_2)**
A. 82.35%
[✓ B. 46.6%]
C. 35%
D. 55.56%

Q.21 **A compound contains 50% sulphur and 50% oxygen by mass. The empirical formula of the compound is**
A. S_2O_3
[✓ B. SO_2]
C. SO_3
D. SO

Q.22 **Empirical formula of vitamin C (Ascorbic aciD. is**
[✓ A. $C_3H_4O_3$]
B. $C_3H_6O_3$
C. $C_4H_8O_7$
D. $C_6H_{12}O_6$

Q.23 **If empirical formula of a compound is CH_2 and its molecular mass is 56amu. What will be its molecular formula**
A. CH_2
B. C_2H_4
C. C_3H_6
[✓ D. C_4H_8]

Q.24 **Molecules formula = n × (empirical formulA., which statement is correct about 'n'**
A. It can never be unity
[✓ B. It can never by zero]
C. It may be negative
D. Not predictable

Q.25 **Styrene has empirical formula CH, and there is 92.2%C and 7.75% hydrogen. If molar mass is 104g mol^{-1}, what will be integral multiple (n) to get molecular formula**
A. 2
B. 4
C. 6
[✓ D. 8]

Q.26 **Combustion analysis is performed for the determination of**
A. Molar mass of the compound
[✓ B. Empirical formula of the compound]
C. Structural formula of the substance
D. Mass of halogens present in organic compounds

Q.27 The stoichiometric calculations for a chemical reaction results in
A. Actual yield [✓ B. Theoretical yield]
C. Percentage yield D. Exprimental yield

Q.28 5604 cm³ of H_2 gas at STP contains atoms of hydrogen
A. 6.02×10^{23} B. 2.6×10^{22}
[✓ C. 3.01×10^{23}] D. 1.50×10^{23}

Q.29 Gram atoms of hydrogen in 5.5g H_2
[✓ A. 5.50] B. 5.45
C. 2.25 D. 2.20

Q.30 4g of an unknown gas occupies 5.6dm³ volume, at S.T.P the gas is
A. SO_2 [✓ B. CH_4]
C. O_2 D. H_2S

Q.31 10 moles of HCl is added to excess to magnesium and forms 4 moles of hydrogen gas percentage yield is
[✓ A. 40%] B. 80%
C. 60% D. 100%

Q.32 Which of the following is a limitation of balanced chemical equation
A. Conditions and rate of reactions
B. Physical state and mechanism
C. Reactants and products and their coefficients
[✓ D. Both A. and B.]

Q.33 How much oxygen is required to react 16g of S to form SO_2
A. 32g B. 24g
[✓ C. 16g] D. 64g

Q.34 Theoretical yield is always less than the actual yield because
A. Some product is lot in the experiment
B. Reversible reaction may occur
C. Errors are made in weighing the reactants or the products
[✓ D. The given statement is not correct]

Q.35 The actual yield of a product is 8g, then theoretical yield will be _____ while reaction is 80% efficient
A. 8g [✓ B. 10g]
C. 12g D. 14g

Q.36 4 moles of hydrogen react with 5 moles of oxygen to form water, identify the excess reagent
[✓ A. Hydrogen] B. Water
C. Oxygen D. All of these

Q.37 If 15g of sulphur are burnt, what volume of SO_2 is produced at STP?
[✓ A. 10.51dm³] B. 30dm³
C. 20dm³ D. 100dm³

Q.38 If you have 3.5 moles of hydrogen and 5 moles of nitrogen to produce ammonia. How much ammonia is produced
A. 34.08g B. 17.04g
[✓ C. 39.6g] D. None of these

Q.39 Which of the following conditions of temperature and pressure are the standard conditions (STP)
A. 0°C and 1 atm pressure B. 32°F and 760 torr
C. 273k and 14.7 PSI [✓ D. All of these]

Q.40 Which one is experimental equation

A. Rate equation

B. Stoichiomeric equation

C. Rate expression

[✓ D. Both A. and C.]

Q.41 2.8g of N_2 molecules contain number of chemical bonds

A. 6.02×10^{22}

B. 1.204×10^{23}

[✓ C. 1.8×10^{23}]

D. 1.8×10^{22}

Q.42 A limiting reactant is one which

A. Is taken in lesser quantity in grams as compared to other reactant

[✓ B. Gives minimum amount of product under consideration]

C. Is taken in lesser quantity in volume as compared to other reactant

D. Gives maximum amount of the product which is required

Q.43 An acid with molecular mass 104 contain 34.6%C, 3.85% H and rest is O. The molecular formula of acid is

[✓ A. $C_3H_4O_4$]

B. $C_2H_2O_4$

C. C_2H_2O

D. C_2HO_2

Q.44 The total number of atoms in 9g of water are

A. 3.01×10^{23}

B. 4.51×10^{23}

C. 6.02×10^{23}

[✓ D. 9.03×10^{23}]

Q.45 One-gram molecule of different gases have all the following properties same at STP except

A. Molecules

B. Moles

C. Volume

[✓ D. Masses]

Q.46 A pair that have same number of molecules

[✓ A. 32g O_2 and 32g N_2H_4]

B. 34g H_2S and 34g N_2H_4

C. 30g N_2 and 30g C_2H_6

D. 44g CO_2 and 44g CS_2

Q.47 One mole of which of the following will have different number of electrons than others

A. Na^{+1}

B. H_2O

C. NH_3

[✓ D. CO^{+1}]

Q.48 The total number of O-atoms in 18g of glucose are

A. 6.02×10^{22}

B. 6.02×10^{23}

[✓ C. 3.6×10^{23}]

D. 3.6×10^{22}

Q.49 21g of CaO is obtained by roasting 50g $CaCO_3$. What is the percentage yield of CaO?

A. 25%

B. 50%

[✓ C. 75%]

D. 60%

Q.50 The absorption of CO_2 in 50% KOH leads to

A. Physical change

B. Simple diffusion

C. Adsorption

[✓ D. Chemical change]

Q.51 For which reaction stoichiometry cannot be studied

A. $N_2 + 3H_2 \rightleftharpoons 2NH_3$

B. $PCl_3 + Cl_2 \rightleftharpoons PCl_5$

C. $N_2O_4 \rightleftharpoons 2NO_2$

[✓ D. All of these]

Q.52 A sample of $100cm^3$ of dilute H_2SO_4 contains 0.1 moles of acid. What is hydrogen ion concentration in the solution per dm^3

[✓ A. 2 moles]

B. 0.50 moles

C. 0.25 moles

D. 1 mole

Q.53 The number of moles of $KMnO_4$ that contain 1 mole of oxygen atom

A. 2 moles
B. 0.5 moles
[✓ C. 0.25 moles]
D. 1.5 moles

Q.54 A pair of compounds that has same empirical formula

[✓ A. Acetic acid and glucose]
B. Acetic acid and formic acid
C. Formic acid and sucrose
D. Ethane and Ethyne

Q.55 Elemental analysis is performed to determine

A. Molar mass of the compound
B. Structural formula of a compound
[✓ C. Empirical formula of a compound]
D. Mass of halogen present in a compound

Q.56 Hydrogen and oxygen have same at STP

A. Gram molecular weight
B. Protons in the molecules
[✓ C. Gram molecular volume]
D. Electrons in the valence shell

Q.57 Equal volumes of N_2O and CO_2 are taken in identical conditions, the correct relation between the masses of two gases is

A. $N_2O > CO_2$
B. $N_2O < CO_2$
[✓ C. $N_2O = CO_2$]
D. $N_2O \geq CO_2$

Q.58 Which one has maximum number of atoms

[✓ A. 1g Mg]
B. 1g Fe
C. 1g Al
D. All have same atoms

Q.59 Which one will produce largest number of negatively charged ions in case of 100% dissociation of 1 mole

[✓ A. $FeCl_3$]
B. Na_2SO_4
C. NaOH
D. $ZnCl_2$

Q.60 1 mole of CH_3OH and C_2H_5OH have equal number

A. C-Atoms
B. H-atoms
[✓ C. O-Atoms]
D. Electrons

ANSWER KEY

1	D	11	A	21	B	31	A	41	C	51	D
2	B	12	A	22	A	32	D	42	B	52	A
3	C	13	B	23	D	33	C	43	A	53	C
4	C	14	B	24	B	34	D	44	D	54	A
5	C	15	C	25	D	35	B	45	D	55	C
6	C	16	B	26	B	36	A	46	A	56	C
7	A	17	C	27	B	37	A	47	D	57	C
8	C	18	D	28	C	38	C	48	C	58	A
9	C	19	D	29	A	39	D	49	C	59	A
10	C	20	B	30	B	40	D	50	D	60	C

2 UNIT ATOMIC STRUCTURE

SELF ASSESSMENT TEST

Q.1 Charge on 1kg of electrons is

A. 9.1095×10^{-31}C

[✓ ●. 1.7588×10^{11}C]

C. 1.602×10^{-19}C

D. 1

Q.2 The mass of neutron is

A. 1.675×10^{-27} kg

B. 1.675×10^{-24}g

C. 1.0087amu

[✓ ●. All of these]

Q.3 The e/m value of He^{+1} ion in comparison to e/m value of electron is

[✓ ●. 7344 times lesser]

B. 1836 times greater

C. 1836 times lesser

D. 7344 times greater

Q.4 What will be the effect on electron when passed through the electric field

[✓ ● Deflection towards anode]

B. Deflection perpendicular to electric field

C. Deflection towards cathode

D. Deflection downwards in electric field

Q.5 X specie carry +3 charge and number of electron and neutrons are 10 and 14 respectively. What is the atomic mass of X

A. 24

B. 21

[✓ ● 27]

D. 17

Q.6 Which of the followings set of ions is isoelectronic

[✓ ●. Sc^{+3}, Ca^{+2}, S^{-2}]

B. F^{-}, Ne and Na

C. H^{-}, H and H^{+}

D. Li^{+}, Na^{+} K^{+}

Q.7 Which of the following particles would on losing an electron has its outermost p-orbital as half filled

A. N atom

[✓ ●. P^{-1} ion]

C. O^{+} ion

D. S^{+1} ion

Q.8 Isotopes differ in

[✓ ●. Properties with respect to their mass number]

B. Properties with respect to their proton number

C. Properties of with respect to their atomic number

D. With respect to chemical properties

Q.9 Which property is same for two nuclides $^{40}_{18}Ar$ and $^{40}_{19}K$

A. Number of electrons

B. Number of neutrons

[✓ ●. Number of nucleons]

D. Number of protons

Q.10 The correct set of four quantum numbers for the valence electron of potassium (Z = 19) is

[✓ ●. n = 4, l = 0, m = 0 and s = +1/2]

B. n = 4, l = 1, m = 0 and s = +1/2

C. n = 4, l = 1, m = 1 and s = +1/2

D. n = 3, l = 0, m = 0 and s = +1/2

Q.11 Identify the correct order of decreasing energy

[✓ ●. 3s > 2s > 1s]

B. 1s > 2s > 3s

C. 2s > 3s > 1s

D. 1s > 3s > 2s

Q.12 Correct number of degenerate orbitals

A. p = 6, d = 10, f = 14

[✓ ●. p = 3, d = 5, f = 7]

C. p = 1, d = 2, f = 3

D. p = 3, d = 7, f = 5

Q.13 The maximum number of electrons in subshell can be calculated by using formula

A. $2\ell + 1$
[✓ B. $2(2l+1)$]
C. $2n^2$
D. $n + l$

Q.14 The incorrect statement about d-orbitals

A. It is not present in first two principle energy levels
[✓ B. They are associated with only transition elements]
C. They are five degenerate orbitals in d-subshell
D. d-orbitals can filled before p-orbitals in the same principle energy level

Q.15 Valence electron of K has ________ value for spin quantum number with ________ spin

A. $+\frac{1}{2}$, clockwise
B. $-\frac{1}{2}$, clockwise
[✓ C. $+\frac{1}{2}$, anticlockwise]
D. $-\frac{1}{2}$, anticlockwise

Q.16 Fourth shell can accommodate 32 electrons how many electron can be placed in 5th shell

[✓ A. 32]
B. 46
C. 40
D. 50

Q.17 The correct set of quantum numbers is

A. $n = 2, \quad \ell = 2, \quad m = 0, \quad s = +\frac{1}{2}$
B. $n = 2, \quad \ell = 1, \quad m = -2, \quad s = +\frac{1}{2}$
[✓ C. $n = 2, \quad \ell = 1, \quad m = 0, \quad s = +\frac{1}{2}$]
D. $n = 2, \quad \ell = 1, \quad m = -2, \quad s = 0$

Q.18 The place between two orbitals where probability for finding the electron is zero known as

A. Anti orbital
[✓ B. Nodal plane]
C. Atomic hole
D. Orbital

Q.19 The shapes of s orbitals is circular and their size:

[✓ A. Increases with the increase in principal quantum number]
B. Decreases with the increase in principal quantum number
C. Remains the same with the change in principal quantum number
D. Increase with the increase in Azimuthal quantum number value

Q.20 The electronic configuration of P(15) is

A. $1s^2,2s^2,2p^6,3s^2,3p_x^1,3p_y^2,3p_z^0$
[✓ B. $1s^2,2s^2,2p^6,3s^2,3p_x^1,3p_y^1,3p_z^1$]
C. $1s^2,2s^2,2p^6,3s^2,3p_x^0,3p_y^1,3p_z^2$
D. $1s^2,2s^2,2p^6,3s^2,3p_x^2,3p_y^1,3p_z^0$

Q.21 The number of d-electrons in Fe^{+2} (Z = 26) is not equal to

A. p electrons in Ne (Z = 10)
B. s electrons in Mg (Z = 12)
C. d electrons in Fe (Z = 26)
[✓ D. p electrons in Ar (Z = 18)]

Q.22 The rule for filling electrons in subshells of atoms is

[✓ A. Aufbau's principle]
B. Pauli exclusion principle
C. Hund's rule
D. All of these

Q.23 When 6d orbital is completed the entering electron goes into

A. 7f
B. 7s
[✓ C. 7p]
D. 7d

Q.24 **Number of orbitals required to place all electrons of an element with atomic number 30**

A. 13
B. 9
●. 15
D. Can't be predicted

Q.25 **Which of the following has 5 unpaired electron in d sub-shell**

A. $_{25}Mn^{+2}$
B. $_{24}Cr^{+1}$
C. $_{26}Fe^{+3}$
●. All of these

Q.26 **Mass of a neutron may be equal to**

A. Mass of proton
B. Mass of proton + positron
●. Mass of proton + electron + neutrino
D. Mass of electron + positron

Q.27 **The difference of radii and energy between first two orbits is**

A. Maximum, minimum
●. Minimum, maximum ✓
C. Both are maximum
α ●. Both are minimum

Q.28 **In the hydrogen atom, when electron jumps from any high energy orbit to second orbit, the radiation emitted will fall in the**

A. UV region
●. Visible region
C. I.R region
D. Microwave region

Q.29 **Slow neutrons are more effective than fast neutrons for purpose of**

A. Diffusion
●. Fission
C. Fusion
D. Penetration

Q.30 **Which one has shortest wavelength when moving with the same velocity**

A. Proton
B. Electron
C. Neutron
●. α-particle

Q.31 **The electronic configuration of metal ion M^{+2} is 2, 8, 14 and its atomic mass is 56. The number of neutrons in its nucleus is**

●. 30
B. 32
C. 34
D. 42

Q.32 **X–rays has wavelength**

A. More than visible
B. Less than γ–rays
C. Equal to cosmic rays
●. Greater than cosmic rays

Q.33 **Which of following has same number of electron as α–particle**

A. Li^+
●. H^+
C. He^+
D. Be^{+2}

Q.34 **The wavelength of which of the following pair is same**

●. Absorption and emission spectrum of the same element
B. X – rays and γ - rays
C. Continuous and line spectrum
D. IR and UV light

Q.35 **In Hydrogen spectrum most energetic transitions of electrons are found in**

●. Lyman series
B. Paschen series
C. Brackett Series
D. Pfund series

Q.36 de–Broglie equation is applicable to only

[✓ Microscopic particles]
B. Magnetic particle
C. Macroscopic particles
D. Neutral particles

Q.37 The last electron in the Na and K can be distinguished by

[✓ Principal quantum number]
B. Azimuthal quantum number
C. Magnetic quantum number
D. Spin quantum number

Q.38 The de-Broglie's wavelength of a particle having momentum 2.2×10^{-24} kgms^{-1} (Planck's constant = 6.6×10^{-34} Js)

A. 0.5 A°
B. 2A°
[✓ 3A°]
D. 3.5A°

Q.39 Number of electrons present in 3d sub-shell of Cu^{+2}

A. 10
B. 8
C. 7
[✓ 9]

Q.40 The atomic number of an element is sixteen. It belongs to period and group number of the periodic table respectively

A. 3, 7
B. 6, 3
[✓ 3, 6]
D. 7, 3

Q.41 Which contains most stable orbitals in the valence shell

[✓ O^{+1}]
B. N^{-1}
C. Mg^{+1}
D. S^{-1}

Q.42 An electron makes a transition from energy state four to two. It will emit a photon of frequency

A. $\frac{E_2 - E_4}{h}$
[✓ $\frac{E_4 - E_2}{h}$]
C. $(E_4 - E_2) \times h$
D. $(E_2 - E_4) \times h$

Q.43 Which order of mass is correct in ascending order

A. $e^- > p^o > n$
B. $e^- < n < p^+$
[✓ $e^- < p^+ < n$]
D. $n > p^+ > e^-$

Q.44 The radius of 4th orbit is greater than first orbit by

A. 4 times
B. 8 times
[✓ 16 times]
D. 12 times

Q.45 Radius of orbit of electron and velocity of electron are

A. Independent of each other
B. Directly proportional to each other
[✓ Inversely proportional to each other]
D. Relationship varies from atom to atom

Q.46 The value of Rydberg constant is

[✓ $1.09678 \times 10^{7} m^{-1}$]
B. $1.9678 \times 10^{7} m^{-1}$
C. $1.09678 \times 10^{6} m^{-1}$
D. $1.09678 \times 10^{8} m^{-1}$

Q.47 **The space between 1s and 2s is called**
A. Free space
B. Orbital
●. Node
D. Antinode

Q.48 **The limiting line of Balmer series lies in**
A. Infra red region
●. Ultraviolet region
C. Visible region
D. Microwave region

Q.49 **Wavelength of a photon of light emitted by a certain source is 200 A° The wave number will be**
A. $5 \times 10^{-3} m^{-1}$
B. $500\ nm^{-1}$
● $5 \times 10^{7} m^{-1}$
D. $500 \times 10^{7}\ m^{-1}$

Q.50 **The highest energy electron of an element in the ground state is characterized by the given quantum numbers $n = 4,\ l = 0\ ,\ m = 0\ ,\ s = +\frac{1}{2}$. The atomic number of element is**
A. 32
●. 19
C. 22
D. 12

Q.51 **Which formula represent wave number of electrons**
A. $1.0678\times10^{7}\left[\frac{1}{n_1}-\frac{1}{n_2}\right]$
●. $1.09678\times10^{7}\left[\frac{1}{n_1^2}-\frac{1}{n_2^2}\right]$
C. $1.09678\times10^{-7}\left[\frac{1}{n_1}-\frac{1}{n_2}\right]$
D. $0.09678\times10^{-7}\left[\frac{1}{n_1^2}-\frac{1}{n_2^2}\right]$

Q.52 **The number of sub-shells in sulphur atom is**
A. 4
B. 6
C. 7
●. 5

Q.53 **The number of orbitals in a sub shell can be calculated by formula**
●. $2l+1$
B. $2(2l+1)$
C. $2n^2$
D. n^2

Q.54 **Which species has same number of electrons in valence shell and penultimate (second last) shell**
A. Na^+
B. O^{-2}
C. Al^{+3}
●. Cl^-

Q.55 **Which of the following does NOT correctly relate the arrangement of electrons**
A. Arrangement of sub shell is given by $(n + l)$ rule
B. Filling of electrons in degenerate orbitals is given by Hund's rule
C. Filling of electrons in an orbital is given by Pauli's exclusion principle
●. Arrangement of electrons in a shell is given by octet rule

Q.56 **The positive rays have maximum e/m value when one of the following gas is used in discharge tube**
A. O_2
C. F_2
●. N_2
D. Cl_2

Q.57 **Which statement is wrong about quantum numbers**
A. 'n' gives the idea of energy and size of an orbit
B. 'l' gives the shape of an orbital
●. 'm' gives the energy of an electron in an orbital
D. 's' gives the direction of spin in an orbital

Q.58 **The value of n = 3. What are probable values of Azimuthal quantum number 'l'**

A. 0, 1, 2, 3
[✓ B. 0, 1, 2]
C. 0, 1
D. 1, 2, 3, 4

Q.59 **Which electronic configuration is not possible?**

[✓ A. $1s^2, 2s^2, 2p^6, 2d^2, 3s^1$]
B. $1s^1$
C. $1s^2, 2s^2, 2p^1_x, 2p^1_y, 2p^1_z$
D. $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2$

Q.60 **How many electrons can fit into the sub-shell for which n = 3, l = 1?**

A. 8
B. 18
[✓ C. 6]
D. 32

ANSWER KEY

1	B	11	A	21	D	31	A	41	A	51	B
2	D	12	B	22	A	32	D	42	B	52	D
3	A	13	B	23	C	33	B	43	C	53	A
4	A	14	B	24	C	34	A	44	C	54	D
5	C	15	C	25	D	35	A	45	C	55	D
6	A	16	A	26	C	36	A	46	A	56	B
7	B	17	C	27	B	37	A	47	C	57	C
8	A	18	B	28	B	38	C	48	B	58	B
9	C	19	A	29	B	39	D	49	C	59	A
10	A	20	B	30	D	40	C	50	B	60	C

3 UNIT GASES, LIQUIDS AND SOLIDS

SELF ASSESSMENT TEST

Q.1 **Gases exert pressure on the walls of the container because the gas molecules**

A. Collide with each other
●. Collide with walls of container
C. Have definite volume
D. Obey the gas laws

Q.2 **Which one of the following is absolute zero**

●. 0 K
B. 20 K
C. 273 K
D. –273K

Q.3 **Crystalline solids are classified on the basis of bonding into ________ types**

A. Two
B. Five
C. Seven
●. Four

Q.4 **The number of molecules in $0.0112m^3$ of methane at 0°C and pressure of 760mm Hg is**

A. 6.02×10^{20}
B. 6.02×10^{23}
C. 3.01×10^{12}
● 3.01×10^{23}

Q.5 **Which of the following will have same number of molecules at STP**

●. 280 cm^3 of CO_2 and 280 cm^3 of N_2O
B. 11.2 dm^3 of O_2 and 32 g of O_2
C. 44g of CO_2 and 11.2 dm^3 CO
D. 28g of N_2 and 5.6 dm^3 of oxygen

Q.6 **The graph between pressure and inverse of volume at constant temperature and number of moles**

A. Straight line parallel to x-axis
●. Straight line passing through the origin
C. Straight line parallel to y-axis
D. None of them

Q.7 **In a closed vessel of 1000 cm^3, H_2 gas is heated from 27°C To 127°C. Which statement is not correct?**

A. The rate of collision increases
B. The energy of gas molecules increases
C. Pressure of gas increases
●. The number of moles of gas increases

Q.8 **The molecules of gas show more deviation from ideal behaviour at low temperature, because**

A. Kinetic energies are increased
B. Densities of the gases increased
C. Collisions become less frequent
●. Attractive force dominate at low temperature

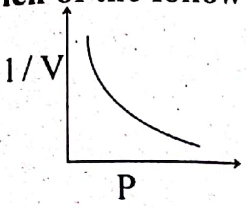
Q.9 **The gas laws are best applicable under the conditions**

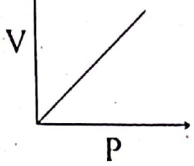
A. High P, Low T
●. Low P, High T
C. High T, and polar gas
D. High P and larger molecular size

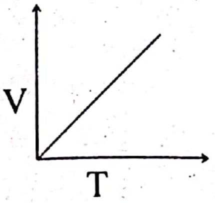
Q.10 **The root mean square velocity is expressed as**

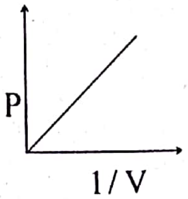
A. $\left(\frac{3}{2}RT\right)^{\frac{1}{2}}$
●. $\left(\frac{3RT}{M}\right)^{\frac{1}{2}}$
C. $\left(\frac{2RT}{M}\right)^{\frac{1}{2}}$
D. $\left(\frac{8RT}{\pi M}\right)^{\frac{1}{2}}$

Q.11 Which of the following is graphical explanation of Boyle's law

A.


B.


C.


●.


Q.12 At constant pressure, volume of a given mass of a gas is directly proportional to
A. Temperature
B. Number of moles
C. Pressure
●. Absolute temperature

Q.13 Absolute zero is unattainable temperature, current attempts have resulted in the lowest temperature of
A. 10^{-1} K
B. 10^{-2} K
●. 10^{-5} K
D. 10^{-7} K

Q.14 If temperature is increasing continuously then constant 'k' in PV = k will
●. Increase
B. Decrease
C. Constant
D. Unpredictable

Q.15 What will happen to density of an ideal gas, if both temperature and pressure are doubled
A. Increase two times
B. Increase four times
C. Decrease four times
●. Remain Same

Q.16 100 m³ of a gas at 3atm and 27°C is transferred into a container having volume 300m³ and temperature 327°C. Pressure in new container will be
●. 2 atm
B. 4 atm
C. 3 atm
D. 6 atm

Q.17 Value of general gas constant 'R' depends upon
A. Nature of gas
B. Mass of gas
C. Units of P and T
●. Units of P and V

Q.18 Which of the following molecules have maximum root mean square velocity at 25°C
A. CO_2
B. H_2S
●. NH_3
D. SO_2

Q.19 Which of the following gas show maximum ideal behavior
A. NH_3
B. CO_2
●. N_2
D. SO_2

Q.20 Which mathematical relationship doesn't correctly represent behavior of an ideal gas
A. $P \propto CT$
B. $PM \propto dT$
●. $P \propto \frac{1}{d}$
D. Both A. and C.

Q.21 The density of methane at 2atm pressure at 27°C is
A. 26 gdm^{-3}
●. 1.3 gdm^{-3}
C. 0.26 gdm^{-3}
D. 0.13 gdm^{-3}

Q.22 The correct mathematical form of Avogadro's law is

A. $P_1V_1=P_2V_2$

●. $\frac{V_1}{V_2}=\frac{n_1}{n_2}$

C. $\frac{V_1}{T_1}=\frac{V_2}{T_2}$

D. $\frac{P_1}{P_2}=\frac{n_1}{n_2}$

Q.23 Which one is most real at STP

●. NH_3

B. He

C. H_2

D. Ar

Q.24 The deviation of a gas from ideal behavior is maximum at

●. –10°C and 5.0 atm

B. 100°C and 2.0 atm

C. –10°C and 2 atm

D. 0°C and 2 atm

Q.25 If absolute temperature is doubled and the pressure is increased to 4 times, the volume of gas is

●. Half

B. Four times

C. Double

D. Unchanged

Q.26 The average K.E. of the gas molecules is

A. Inversely proportional to its absolute temperature

●. Directly proportional to its absolute temperature

C. Equal to the square of its absolute temperature

D. Directly proportional to the square root of its absolute temperature

Q.27 The compressibility factor (Z) for an ideal gas is

A. Zero

B. Less than 1

C. Greater than 1

●. Equal to one

Q.28 If we increase or decrease the amount of heat to a liquid, its boiling point will

A. Increase

●. Remain constant

C. Decrease

D. Increase or decrease accordingly

Q.29 Which is the correct order of boiling points

●. $H_2O > HF > NH_3 > CH_4$

B. $H_2O > HF > CH_4 > NH_3$

C. $H_2O > NH_3 > HF > CH_4$

D. $H_2O > NH_3 > CH_4 > HF$

Q.30 Evaporation of water depends upon the following

A. Surface area and intermolecular forces

B. Speed of the air above the liquid surface

C. Humidity in air

●. All of these

Q.31 110°C boiling point of water corresponds to the external pressure

●. Between 760 to 1200 torr

B. Between 200 to 760 torr

C. 765 torr

D. Any value of pressure

Q.32 The boiling point of compound is mostly raised by

A. Dipole induced dipole interaction

●. Inter-molecular Hydrogen bonding

C. London dispersion forces

D. Intra-molecular Hydrogen bonding

Q.33 Which has greater enthalpy of vapourization

A. F_2

B. Cl_2

C. Br_2

●. I_2

Q.34 Identify incorrect statement about evaporation

A. Continuous

●. Exothermic

C. Cooling

D. Surface Phenomenon

Q.35 Maximum vapour pressure is shown by
A. 1dm^3 water
B. 1dm^3 ethanol
C. 50 cm^3 ethanol
●. Both C. and B.

Q.36 Evaporation occurs at
A. 25°C
B. 0°C
C. 40°C
●. All temperatures

Q.37 Which one is the most accurate method for the measurement of vapour pressure
A. Barometric method
B. Dilatometric method
●. Manometric method
D. Optical rotation method

Q.38 The vapour pressure of methanol at 40°C is less than
A. Water
B. Glycerin
● Ether
D. Acetic acid

Q.39 Ionic crystals are characterized by
A. Low melting point
●. Solubility in polar solvents
C. High vapour pressure
D. Good conductivity in solid state

Q.40 NaCl crystal is
●. Cubic
B. Tetragonal
C. Hexagonal
D. Triclinic

Q.41 Which element exists as discrete small molecule in the solid state
A. Aluminium
●. Iodine
C. Sodium chloride
D. Diamond

Q.42 Ice floats on the liquid water because
A. Density of water is maximum at 4°C
●. Water freezes at 0°C and is less dense than liquid water
C. Ice occupies less volume than water at 0°C
D. Both C. and B.

Q.43 Density of unknown gas 'X' is 1.98g/dm^3 at STP. Unknown gas is
●. CO_2
B. CH_4
C. Cl_2
D. O_2

Q.44 The number of Cl^{-1} ions per unit cell of NaCl are
A. 6
B. 2
●. 4
D. 8

Q.45 The crystal of diamond is
A. Ionic
●. Covalent
C. Molecular
D. Metallic

Q.46 One unit cell of NaCl contains ion pairs

A. Two
B. Six
[✓ C. Four]
D. Eight

Q.47 The share of Na^+ ion on each edge in NaCl unit cell is

A. 1/8
B. 1/3
C. 1/2
[✓ D. 1/4]

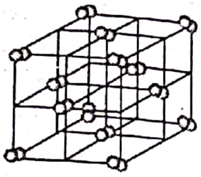
Q.48 Silicon (IV) oxide crystal is an example of

A. Ionic crystal
B. Metallic crystal
[✓ C. Covalent crystal]
D. Molecular crystal

Q.49 Carbon atom in diamond is

A. sp hybridized
B. sp^2 hybridized
[✓ C. sp^3 hybridized]
D. dsp^2 hybridized

Q.50 The given crystal lattice is for



A. Sodium chloride
B. Ice
C. Diamond
[✓ D. Iodine]

Q.51 The volume of ice on freezing $200cm^3$ of water will be

A. $109cm^3$
[✓ B. $218cm^3$]
C. $209cm^3$
D. $200cm^3$

Q.52 I – I bond distance difference between $I_{2(g)}$ and $I_{2(s)}$ is

A. 271.5 pm
B. 266.6 pm
[✓ C. 4.9 pm]
D. 9.6 pm

Q.53 Which one of the following contains maximum hydrogen bonding

[✓ A. H_2O]
B. HF
C. NH_3
D. C_2H_5OH

Q.54 Ammonia shows the maximum boiling point because of

A. Lone pair of electrons present on nitrogen
B. Very small size of nitrogen
C. Pyramidal structure of ammonia
[✓ D. Enhanced electronegativity character of nitrogen]

Q.55 The boiling point of H_2O is 100°C while that of C_2H_5 OH is 78.37°C. The reason is that

A. H_2O molecules are small sized
B. The bond angles at oxygen atom are different
C. C_2H_5 group is electron donating
[✓ D. The number of hydrogen bonds per H_2O molecule are greater than C_2H_5OH]

Q.56 Which of the following in liquid state has lowest boiling point?

A. CH_3COOH
[✓ B. CH_3OH]
C. H_2O
D. C_2H_5OH

Q.57 **In which of the following pairs, Debye forces exist**

A. Water and ethanol
[✓ B.] Argon and water
C. Methane and ethane
D. Water and Na$^+$ ion

Q.58 **Kerosene oil is liquid at room temperature due to**

A. Debye forces
[✓ B.] London dispersion forces
C. Hydrogen bonding
D. Dipole - dipole forces

Q.59 **The heat of vaporization of H_2O, C_2H_5OH and CS_2 are 40.6 kJ/mol, 38.6kJ/mol and 28.6kJ/mol respectively. The order of decreasing intermolecular forces in these liquids is**

[✓ A.] $H_2O > C_2H_5OH > CS_2$
B. $H_2O > CS_2 > C_2H_5OH$
C. $CS_2 > C_2H_5OH > H_2O$
D. $CS_2 > H_2O > C_2H_5OH$

Q.60 **The different substances are given along with their boiling points in the following table**

Substance	Boiling Point	Substance	Boiling Point
HF	19.9°C	C_2H_5OH	78.37°C
NH_3	–33.34°C	$C_2H_5OC_2H_5$	34.6°

Select the substance having weakest intermolecular forces

A. HF
B. C_2H_5OH
[✓ C.] NH_3
D. $C_2H_5OC_2H_5$

ANSWER KEY

1	B	11	D	21	B	31	A	41	B	51	B
2	A	12	D	22	B	32	B	42	B	52	C
3	D	13	C	23	A	33	D	43	A	53	A
4	D	14	A	24	A	34	B	44	C	54	D
5	A	15	D	25	A	35	D	45	B	55	D
6	B	16	A	26	B	36	D	46	C	56	B
7	D	17	D	27	D	37	C	47	D	57	B
8	D	18	C	28	B	38	C	48	C	58	B
9	B	19	C	29	A	39	B	49	C	59	A
10	B	20	C	30	D	40	A	50	D	60	C

4
UNIT

CHEMICAL EQUILIBRIUM AND REACTION KINETICS

SELF ASSESSMENT TEST

Q.1 **For a reversible reaction, $A \longrightarrow B$, which expression describe rate of forward reaction**

A. $\frac{d[A]}{dt}$
●. $-\frac{d[A]}{dt}$
C. $\frac{d[B]}{dt}$
D. $-\frac{d[B]}{dt}$

Q.2 **Consider the reaction $PCl_{5\,(g)} \rightleftharpoons PCl_{3\,(g)} + Cl_{2\,(g)}$ in a closed container at equilibrium. At a fixed temperature, what will be the effect of adding more PCl_5 on the equilibrium constant**

A. It increases
B. It decreases
● It remains unaffected
D. Can't be predicted without K_P

Q.3 **In $2HI \rightleftharpoons H_2 + I_2$, $\Delta H > 0$ the forward reaction is affected by change in**

A. Catalyst
● Temperature
C. Volume
D. Pressure

Q.4 **The reaction quotient (Q) for the reaction $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$ is given by $Q = \frac{[NH_3]^2}{[N_2][H_2]^3}$, the reaction will proceed from right to left is**

A. $Q = 0$
B. $Q = Kc$
C. $Q < Kc$
● $Q > Kc$

Q.5 **Which value of Kc indicate maximum yield of products**

●. $Kc = 10^2$
B. $Kc = 1$
C. $Kc = 10^{-2}$
D. $Kc = 10^{-3}$

Q.6 **The equilibrium constant for the reaction $N_{2(g)} + O_{2(g)} \rightleftharpoons 2NO_{(g)}$ is 4.4×10^{-4} at 2000K temperature. In the presence of catalyst, equilibrium is attained ten times faster. Therefore, the equilibrium constant in presence of catalyst at 2000K is**

●. 4.4×10^{-4}
B. 4.4×10^{-5}
C. 4.4×10^{-3}
D. Difficult to compute

Q.7 **Ratio of K_p/K_c for the reaction $CO_{(g)} + \frac{1}{2}O_{2(g)} \rightleftharpoons CO_{2(g)}$ is**

A. 1
B. $(RT)^{\frac{1}{2}}$
C. RT
● $(RT)^{-\frac{1}{2}}$

Q.8 **What is the equilibrium expression for the reaction $N_2 + 3H_2 \rightleftharpoons 2NH_3$**

A. $Kc = \frac{[NH_3]}{[N_2][H_2]}$
B. $Kc = \frac{[2NH_3]}{[N_2]+[3H_2]}$
C. $Kc = \frac{[N_2][H_2]^3}{[NH_3]^2}$
●. $Kc = \frac{[NH_3]^2}{[N_2][H_2]^3}$

Q.9 For the reaction $CO_{(g)} + Cl_{2(g)} \rightleftharpoons COCl_{2(g)}$, then $\frac{Kp}{Kc}$ is equal to

[✓ A. $\frac{1}{RT}$]
B. RT
C. $\sqrt{RT}$
D. 0.1

Q.10 For reaction $PCl_{5(g)} \rightleftharpoons PCl_{3(g)} + Cl_{2(g)}$ unit of Kp is

[✓ A. atm]
B. atm^{-1}
C. atm^{-2}
D. atm^{2}

Q.11 $2A + B \rightleftharpoons C$. At equilibrium 0.20 mole of A, 0.45 mole of B and 0.15 mole of C are present, Calculate K_c

[✓ A. 8.3]
B. 5.0
C. 4.0
D. 6.0

Q.12 4 moles of A are mixed with 4 moles of B. At equilibrium for the reaction $A + B \rightleftharpoons C + D$, 2 moles of C and D are formed, the equilibrium constant for reaction will be

A. $\frac{1}{4}$
B. 4
C. $\frac{1}{2}$
[✓ D. 1]

Q.13 $PCl_{5(g)} \rightleftharpoons PCl_{3(g)} + Cl_{2(g)}$ is of equilibrium, the concentration of $PCl_{3(g)}$ is doubled then reaction with shift towards

[✓ A. Left]
B. Right
C. Neither left nor right
D. First left then right

Q.14 The most suitable temperature for preparing ammonia gas is

A. 250°C
B. 350°C
[✓ C. 450°C]
D. 550°C

Q.15 Which one is correct about conjugate acid-base concept?

A. Conjugate base of a very weak acid is relatively very strong
B. Conjugate base of a very weak acid is relatively very weak
C. Conjugate base of a very strong acid is relatively very weak
[✓ D. Both A and C]

Q.16 What is the conjugate base of OH^-

A. O_2
B. H_2O
C. O^{-1}
[✓ D. O^{-2}]

Q.17 Ostwald's dilution law is applicable for

[✓ A. Weak electrolyte]
B. Both A. and C.
C. Strong electrolyte
D. None of these

Q.18 If pKa of an acid is 5, then pKb of its conjugate base will be ____ at 25°C.

A. 10
[✓ B. 9]
C. 8
D. 5

Q.19 The units of ionic product of H_2O is

A. Mol dm^{-3}
B. $Mol^{-1}dm^{-3}$
[✓ C. $Mol^{2}dm^{-6}$]
D. $Mol^{-2}dm^{-6}$

Q.20 **Which is correct relation at 100°C**

A. $pH + pOH < 14$
B. $pKa + PKb < 14$
C. $[H^+][OH^-] > 10^{-14}$
[✓ D.] All of these

Q.21 **pH of 10^{-4} molar solution of HX acid in water is**

A. −4
B. Between 3 and 4
[✓ C.] 4
D. 7

Q.22 **What will be the pH of 1.0 mol dm $^{-3}$ of NH_4OH, which is 1% dissociated**

A. 2
B. 0
[✓ C.] 12
D. 2.7

Q.23 **Which one of the following has the lowest pH values**

[✓ A.] 0.1M HCl
B. 0.1M KOH
C. 0.01M HCl
D. 0.01M KOH

Q.24 **Which one is best buffer those have**

[✓ A.] $pH = pK_a$
B. $pOH < pK_b$
C. $pH > pK_a$
D. $pK_a = 0$

Q.25 **An acidic buffer solution can be prepared by mixing**

[✓ A.] Weak acid and its salt with strong base
B. Strong acid and its salt with weak base
C. Weak base and its salt with strong acid
D. Strong base and its salt with strong acid

Q.26 **pH of buffer solution is 4.74, pKa of acid is 4.74. What is ratio between concentration of salt and acid**

A. 10
[✓ B.] 1
C. 0.1
D. 0.3

Q.27 **If the concentration of salt is greater than the acid in buffer solution, then the**

A. $pH = pK_a$
[✓ B.] $pH > pK_a$
C. $pH = pK_b$
D. $pH < pK_b$

Q.28 **Expression of solubility product constant (Ksp) for following sparingly soluble salt is**

$AxBy \rightleftharpoons xA^{+y} + yB^{-x}$

[✓ A.] $[A^{+y}]^x[B^{-x}]^y$
B. $[A^{-y}]^x[B^{-x}]^y$
C. $[A^{y}]^y[B^{-x}]^x$
D. $[x^{A}]^y[y^{-B}]^x$

Q.29 **The solubility of $Fe(OH)_3$ is 'x' mole per dm^3. Its K_{sp} would be**

A. $9x^3$
[✓ C.] $27x^4$
B. $3x^4$
D. $9x^4$

Q.30 **Which one increases by common ion effect except?**

A. Crystallization
[✓ C.] Solubility
B. Association of ions
D. All of these

Q.31 **$AgNO_{3(aq)} + NaCl_{(aq)} \longrightarrow AgCl + NaNO_3$ which one is correct about given reaction**

A. It is very slow reaction
[✓ C.] It is very fast reaction
B. It proceed at moderate rate
D. Black participate

Q.32 **The unit of rate constant is the same as that of the rate of reaction in**

A. 1st order reaction
[✓ C.] Zero order reaction
B. 2nd order reaction
D. 3rd order reaction

Q.33 **The rate of reaction is doubled for every 10°C rise in temperature. The increase in reaction rate as a result of temperature rise from 10 °C to 100 °C is**

A. 112
C. 400
[✓ B.] 512
D. 614

Q.34 **The mathematical relation between the rate of reaction and the concentrations of the reactants is known as the**

A. Order of reaction
B. Half-life period
C. Arrhenius equation
●. Rate law equation

Q.35 **If 75% of any given amount of radioactive element disintegrates in 60 min. The half-life of radioactive element is**

A. 20 min
B. 45 min
●. 30 min
D. 25 min

Q.36 **The energy of activated complex is**

A. Less than reactants
B. Greater than reactants
C. Greater than products
●. Both B and C

Q.37 **The rate of reaction depends upon**

●. Molar concentration
B. Atomic mass
C. Equivalent mass
D. None of these

Q.38 **For a first-order reaction, the half-life period is independent of**

●. Initial concentration
B. Cube root of initial concentration
C. First power of final concentration
D. Square root of final concentration

Q.39 **If the rate of the reaction is equal to the rate constant, the order of the reaction is**

A. 3
●. 0
C. 1
D. 2

Q.40 **Which of the following is incorrect about order of reaction**

A. It is calculated experimentally
B. It is sum of powers of concentration in rate law expression
●. The order of reaction cannot be fractional
D. There is not necessarily a connection between order and stoichiometry of a reaction

Q.41 **For the reaction $A+B+C \longrightarrow$ Product, Rate $= K[A]^{\frac{1}{2}}[B]^{\frac{1}{3}}[C]$. The order of reaction is**

A. 3
B. 1
C. $\frac{5}{6}$
●. $\frac{11}{6}$

Q.42 **The half-life period of a first order reaction is 15 minutes. The amount of substance left after one hour will be**

A. $\frac{1}{2}$
B. $\frac{1}{4}$
C. $\frac{1}{8}$
●. $\frac{1}{16}$

Q.43 **For an exothermic reaction, an activation energy of forward reaction 70kJmol^{-1} and the enthalpy change of reaction is 30 kJ mol^{-1}. The activation energy for reverse reaction is**

A. 70 kJ mol^{-1}
B. 30 kJ mol^{-1}
C. 40 kJ mol^{-1}
●. 100 kJ mol^{-1}

Q.44 **According to the Arrhenius equation a straight line is to be obtained by plotting the logarithm of the rate constant against**

A. T
B. Log T
●. $\frac{1}{T}$
D. Log$\frac{1}{T}$

Q.45 **Select the correct rate law from given data**

[A] moles dm^{-3}	[B] moles dm^{-3}	Rate of reaction (moles dm^{-3} sec^{-1})
0.1	0.1	1×10^{-4}
0.2	0.1	2×10^{-4}
0.3	0.1	3×10^{-4}
0.3	0.2	12×10^{-4}

A. Rate = $k[A][B]$
B. Rate = $k[A]^2[B]$
C. Rate = $k[A]^{\circ}[B]^2$
[✓ D. Rate = $k[A][B]^2$]

Q.46 **Mixture of H_2 and Cl_2 will react twice as fast, if partial pressure of H_2 or Cl_2 is**
A. Decreased from 1 to 0.5 atm
B. increased from 0.5 to 2 atm
[✓ C. Increase from 0.5 to 1 atm]
D. Decreased from 2 to 1 atm

Q.47 **Select the suitable catalyst for given reaction**

$$HCOOH \longrightarrow H_2O + CO_2$$

[✓ A. Cu]
B. SiO_2
C. Al_2O_3
D. NO

Q.48 **For which of the following reactions Kp > Kc**
A. $H_{2(g)} + F_{2(g)} \rightleftharpoons 2HF_{(g)}$
[✓ B. $PCl_{5(g)} \rightleftharpoons PCl_{3(g)} + Cl_{2(g)}$]
C. $2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$
D. $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$

Q.49 **The equilibrium expression for reaction is $Kc = \dfrac{4x^2V}{(a-2x)^2(b-x)}$ for a gaseous phase reaction then which of the following is true**
A. $K_p = K_c$
B. $K_p > K_c$
[✓ C. $K_p < K_c$]
D. $K_p \geq K_c$

Q.50 **In the given $2A + B \longrightarrow$ products it is observed on quadrupling the conc. of B, rate is increases 16times. The order of reaction with respect to B is**
A. 0
B. 1
C. –1
[✓ D. 2]

Q.51 **The rate of reaction $A + B + C \longrightarrow$ Products is given by Rate = $k[A][B]^{\circ}[C]$. If A is in excess, the order of reaction would be**
A. 0
[✓ B. 1]
C. 2
D. 3

Q.52 **A reaction is first order with respect to A and second order with respect to B. The rate equation is**
[✓ A. Rate = $k[A][B]^2$]
B. Rate = $k[A][B]$
C. Rate = $k[A]^2[B]$
D. Rate = $k[A]$

Q.53 **If the half-life for a particular reaction is found to be constant and independent of initial concentration of reactant then reaction is of**
[✓ A. 1st order]
B. 2nd order
C. 3rd order
D. Zero order

Q.54 **What is the half-life period of the given reaction when initial concentration of HI is 0.050M and rate constant "k" is 0.080 dm^{3}mol^{-1}sec^{-1} $\left(2HI_{(g)} \rightleftharpoons H_{2(g)} + I_{2(g)}\right)$**
A. 150 sec
B. 125 sec
C. 1000 sec
[✓ D. 250 sec]

Q.55 **What will be the half life period of 1st order reaction, if value of rate constant "k" is 0.3465 min^{-1}**

A. 0.5 mint
●. 2.0 mint
C. 1.0 mint
D. 1.5 mint

Q.56 $2A + 2B \longrightarrow D + E$ **for the reaction following the mechanism has been proposed**

$A + 2B \longrightarrow 2C + D$ **(slow)**

$A + 2C \longrightarrow E$ **(fast)**

Select the correct law equation

A. $Rate = k[A]^2[B]^2$
B. $Rate = k[A]^2[B]^2[C]$
●. $Rate = k[A][B]^2$
D. $Rate = k[A][B]$

Q.57 **What will be the rate constant for 2nd order reaction, when rate of reaction is 4 moles dm^{-3} sec^{-1} and concentration of A is equal to concentration of B which is 0.1 moles dm^{-3}**

●. 400 mol^{-1} $dm^{+3}sec^{-1}$
B. 40000 mol^{-1} $dm^{+3}sec^{-1}$
C. 4000 sec^{-1}
D. 4000 mol^{-1} $dm^{+3}sec^{-1}$

Q.58 **Which method for the rate determination is applicable if a reactant or a product absorbs UV/ visible or IR radiation**

●. Spectrometric method
B. Dilatometric method
C. Optical rotation method
D. Refractometric method

Q.59 **What will be rate of reaction, when change in concentration of substance is 3×10^{-3} moles dm^{-3} in 10 sec**

A. 3×10^{-3} mol dm^{-3} sec^{-1}
B. 3×10^{-2} mol dm^{-3} sec^{-1}
●. 3×10^{-4} mol dm^{-3} sec^{-1}
D. 3×10^{2} mol dm^{-3} sec^{-1}

Q.60 **The unit of rate constant of 1st order reaction is**

A. $Moldm^3sec^{-1}$
B. $Mol^{-1}dm^{+3}sec^{-1}$
●. sec^{-1}
D. $Mol^{-2}dm^{+6}sec^{-1}$

ANSWER KEY

1	B	11	A	21	C	31	C	41	D	51	B
2	C	12	D	22	C	32	C	42	D	52	A
3	B	13	A	23	A	33	B	43	D	53	A
4	D	14	C	24	A	34	D	44	C	54	D
5	A	15	D	25	A	35	C	45	D	55	B
6	A	16	D	26	B	36	D	46	C	56	C
7	D	17	A	27	B	37	A	47	A	57	A
8	D	18	B	28	A	38	A	48	B	58	A
9	A	19	C	29	C	39	B	49	C	59	C
10	A	20	D	30	C	40	C	50	D	60	C

5
UNIT
THERMOCHEMISTRY AND ELECTROCHEMISTRY
SELF ASSESSMENT TEST

Q.1 One Joule is equivalent to

A. 4.184 Cal.

B. 0.4184 Cal.

C. $\frac{1}{2}$ Cal.

●. $\frac{1}{4.184}$ Cal.

Q.2 The enthalpies of all elements in their standard states are

A. Unity

B. Always –ve

C. Always +ve

●. Zero

Q.3 ____________ is not a state function

A. Enthalpy

B. Internal energy

C. Temperature

●. Heat

Q.4 No work is done at constant

A. P

●. V

C. T

D. None

Q.5 For an endothermic reaction, enthalpy of reactants

●. Is smaller than that of the products

B. Is greater than that of the products

C. Is equal to that of the products

D. Must be greater or smaller than that of the products

Q.6 Most of the reactions which give stable products are

A. Endothermic

●. Exothermic

C. Isothermal

D. Non of these

Q.7 Decomposition of H_2O is

●. Endothermic reaction

B. Nuclear reaction

C. Exothermic reaction

D. Zero nuclear reaction

Q.8 What type of reaction constitute a limiting case between spontaneous and non-spontaneous reaction

A. Irreversible reactions

●. Reversible reactions

C. Nuclear reactions

D. Thermal reactions

Q.9 In an endothermic reaction

A. $E_R > E_P$

●. $E_R < E_P$

C. $E_R = E_P$

D. None of these

Q.10 In an exothermic reaction the heat energy is _______ while in endothermic reaction it is __________

A. Released, released

●. Released, absorbed

C. Absorbed, released

D. Absorbed, absorbed

Q.11 Whenever a reaction is endothermic, then it means that

●. Heat is transferred from surrounding to the system

B. Heat is transferred system to the surrounding

C. Heat content of the products is less than that of reactants

D. Het content of the reactants is greater than the products

Q.12 Enthalpy of neutralization of strong acids and strong bases have same values because

A. Neutralization leads to the formation of salt and water

B. Strong acids and bases are ionic substances

C. Acids always give rise to H^+ and bases always furnish OH^{-1} ions

●. The net change involves the combination of H^+ and OH^{-1} ions to form water

Q.13 **The measurement of enthalpy change at standard conditions means that we should manage the measurement at**

A. 24°C at 1 atm
[✓ B. 25°C at 1 atm]
C. 0°C at 1 atm
D. 100°C1 atm

Q.14 **The enthalpy change for the reaction $C_2H_2 + \frac{5}{2}O_2 \longrightarrow 2CO_2 + H_2O$ is known as enthalpy of**

A. Formation of CO_2
B. Fusion of C_2H_2
[✓ C. Combustion of C_2H_2]
D. Vaporization of C_2H_2

Q.15 **$BaCl_{2(aq)} + H_2SO_{4(aq)} \rightarrow BaSO_{4(s)} + HCl_{(aq)}$ $\Delta H = -22.4 kJ/mole$, the heat change represented by above equation is called**

A. Heat of formation of $BaSO_4$
B. Heat of dissociation of $BaSO_4$
[✓ C. Heat of reaction]
D. Sum of all the above heats

Q.16 **The enthalpy of atomization of $H_{2(g)}$ is 218 kJ/mole, the enthalpy of formation of $H_{2(g)}$ from gaseous atoms**

$\frac{1}{2}H_{2(g)} \longrightarrow H_{(g)}$ $\Delta H^\circ_{at} = 218 kJ\ mol^{-1}$

A. -218 kJ/mole
[✓ B. – 436 kJ/mole]
C. –109 kJ/mole
D. +218 kJ/mole

Q.17 **An enthalpy change which is always exothermic**

A. ΔH°_{at}
[✓ B. ΔH°_n]
C. $\Delta H^\circ_{solution}$
D. ΔH°_f

Q.18 **The enthalpy change for the reaction,**
$C_2H_2 + 5/2O_2 \rightarrow 2CO_2 + H_2O$ is known as enthalpy of

A. Formation of CO_2
[✓ B. Combustion of C_2H_2]
C. Fusion of C_2H_2
D. Vaporization of C_2H_2

Q.19 **Which of the following gases have the highest heat of combustion**

A. Methane
B. Ethylene
C. Ethane
[✓ D. Acetylene]

Q.20 **Which one of the following pairs has maximum enthalpy of neutralization**

[✓ A. HCl + NaOH]
B. KOH + CH_3COOH
C. HCl + NH_4OH
D. NH_4OH + CH_3COOH

Q.21 **ΔH of a system can be calculated by which of following relationship**

[✓ A. $q = m \times s \times \Delta T$]
B. $q = \Delta E$
C. $q = m \times v \times \Delta T$
D. $q = m \times c \times \Delta E$

Q.22 **Bomb calorimeter is used to determine the**

A. ΔH°_s
[✓ B. ΔH°_c]
C. ΔH°_i
D. ΔH°_n

Q.23 **What is the unit of molar heat capacity**

[✓ A. $Jmol^{-1}k^{-1}$]
B. $g^{-1}K^{-1}$
C. $Jg^{-1}K^{-1}$
D. $g^{-2}\ K^{-2}$

Q.24 **Which is true about lattice energy of an ionic compound**

A. Cannot be determined directly
B. Can be obtained by means of Born Haber cycle
C. Is helpful in discussing bonding and properties of ionic compounds
[✓ D. All of above]

Q.25 The enthalpy of formation of an ionic compound is -392 kJ / mol. Total energy changes (ΔH_x) involved in the formation of gaseous ions from normal physical state is 280 kJ/mol. The enthalpy of lattice($\Delta H_{latt.}$) is

A. -112 kJ /mol

B. + 672 kJ/mol

●. - 672 kJ / mol

D. + 224 kJ / mol

Q.26 Choose from the followings the correct statement about Born Haber cycle

A. Born Haber cycle is different from Hess's law

B. The energy changes in a cyclic process is not zero

●. The lattice energy of crystalline substances can be calculated easily

D. None of these

Q.27 Standard heat of formation of Al_2O_3 cannot determined directly because

A. It reacts with CO_2

B. it does not catch fire

● Protective layer of Al_2O_3

D. Al and O_2 do not react

Q.28 Heat of combustion of graphite at 25°C is -393.51 kJ mol^{-1} and that of diamond is -395.41 kJ mol^{-1}. What is the enthalpy for the conversion of graphite into diamond at same temperature

A. -1.5kJ mol^{-1}

B. $+1.2$kJ mol^{-1}

C. -2.7 kJ mol^{-1}

●. $+1.9$ kJ mol^{-1}

Q.29 Using the hypothetical information given in the table below,

Reactions	**ΔH**
$K_{(s)} + \frac{1}{2}Br_{2(l)} \longrightarrow KBr_{(s)}$	-400kJmol^{-1}
$K_{(s)} \longrightarrow K_{(g)}$	$+100$kJmol^{-1}
$K_{(g)} \longrightarrow K^+_{(g)} + e^-$	$+400$kJmol^{-1}
$\frac{1}{2}Br_{2(l)} \longrightarrow Br_{(g)}$	$+100$kJmol^{-1}
$Br_{(g)} + e^- \longrightarrow Br^-_{(g)}$	-350kJmol^{-1}

Calculate the lattice energy of formation of potassium bromide.

A. $+672$kJmol^{-1}

B. -672kJmol^{-1}

C. $+650$kJmol^{-1}

●. -650kJmol^{-1}

Q.30 By applying Hess's law we can calculate

●. ΔH

B. ΔT

C. ΔP

D. ΔV

Q.31 Which change in oxidation state takes place in nitrogen?

$$Cu + HNO_3 \rightarrow Cu(NO_3) + NO_2 + H_2O$$

A. +5 to −2

●. +5 to +4

C. +5 to 0

D. 0 to −4

Q.32 The +1oxidation state of 'P' is found in

A. H_3PO_3

●. H_3PO_2

C. H_3PO_4

D. $H_3P_2O_7$

Q.33 The oxidation number of phosphorous in the compounds $|PCl_4|^+$ and $|PCl_6|^-$ are respectively

A. +1 and −1

B. +5 and +3

C. +2 and −6

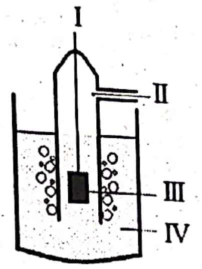
●. +5 and +5

Q.34 **The value of reduction potential of elements is independent upon**
A. Change in temperature
[✓ Change in pressure]
C. Change in concentration
D. All of these

Q.35 **The potential set up when an electrode is in contact with one molar solution of its own ion at 298K. This potential is represented by**
A. ΔE
[✓ E°]
C. ΔE°
D. E

Q.36 **SHE is used as a**
A. Scale
B. Electrolyte
[✓ Reference electrode]
D. All of these

Q.37 **In diagram of standard hydrogen electrode, which labelled part represents one molar solution of HCl.**



A. I
B. III
C. II
[✓ IV]

Q.38 **The reduction potential of aluminum is – 1.66V. The oxidation potential of Al will be**
A. –1.66V
B. 0.0V
[✓ +1.66V]
D. –3.32V

Q.39 **Which is incorrect statement for the element present at the top of electrochemical series**
A. It has greater tendency to get oxidized
B. It can easily replace H_2 from dilute acid
[✓ It has large positive reduction potential value]
D. It can reduce the metal lower in electrochemical series

Q.40 **The ability of elements to act as reducing agent _______ down to electrochemical series**
A. Increases
[✓ Decreases]
C. Remains constant
D. Depends upon the reaction conditions

Q.41 **For the cell** $\mathbf{Cu^{+2}_{(aq)} + Zn_{(s)} \longrightarrow Cu_{(s)} + Zn^{+2}_{(aq)}}$ **when** $\mathbf{E^{\circ}_{Zn/Zn^{+2}} = +0.76V}$ **and** $\mathbf{E^{\circ}_{Cu^{+2}/Cu} = +0.34V}$ **then cell voltage is**
A. 0.10 V
B. 10.1 V
[✓ 1.10 V]
D. 0.55 V

Q.42 **The reaction taking place at cathode is**
A. Oxidation
[✓ Reduction]
C. Neutralization
D. Hydrolysis

Q.43 **The two half cells of the galvanic cell are connected with each other through a salt bridge which**
A. Carries the electrons from one half cell to the other
B. Carries the ions from one half cell to the other
[✓ Indicates the value of the e.m.f. of cell]
D. Carries out the electrolysis

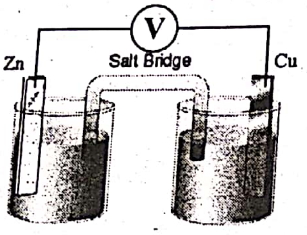
Q.44 **Given standard reduction potential for**
$Fe^{+2}+2e^{-}\rightarrow Fe$, $E_{red}=-0.440V$
$Fe^{+3}+3e^{-}\rightarrow Fe$, $E_{red}=-0.036V$
The standard electrode potential for
$Fe^{+3}+e^{-}\rightarrow Fe^{+2}$ is

A. –0.476
●. 0.404
C. +0.476
D. –0.404

Q.45 **The reduction potential of Cu = +0.34V and Zn = -0.76V. When these two are coupled the emf of cell is**

A. -0.42V
B. -1.10V
C. +0.42V
●. +1.10V

Q.46 **For the given cell which of the following statement is true**



A. Zn acts as cathode
B. Cu acts as anode
● Electrons flow from Zn to Cu through external circuit
D. Electrons flow from Cu to Zn through external circuit

Q.47 **Which of the following reaction is not feasible**

A. $CuSO_4+Fe\longrightarrow$
B. $Mg+2HCl\longrightarrow$
●. $MgSO_4+Zn\longrightarrow$
D. $2H_{2(g)}+O_{2(g)}\longrightarrow$

Q.48 **In the following cell representation**

$Zn_{(s)}|Zn^{2+}_{(aq)}(1M)||Cu^{2+}_{(aq)}(1M)|Cu_{(s)}$

The line | in the representation shows

A. Electrode
●. Phase boundary
C. Salt bridge
D. Molar concentration

Q.49 **Not correct about fuel cell**

A. light and portable
B. Enviromental friendly
C. Hydrogen diffuses through porous cathode
●. Electons flow through external circuit form anode to cathode

Q.50 **Cell reaction which can be used in the fuel cell**

A. $2NH_{3(g)}+3/2O_{2(g)}\longrightarrow N_{2(g)}+3H_2O_{(\ell)}$
B. $N_2H_{4(\ell)}+O_{2(g)}\longrightarrow N_{2(g)}+2H_2O_{(\ell)}$
C. $CH_{4(g)}+2O_{2(g)}\longrightarrow CO_{2(g)}+2H_2O_{(l)}$
●. All of these

Q.51 **The cell in which electrical energy is converted into chemical energy is**

A. Galvanic cell
B. Voltaic cell
● Electrolytic cell
D. All of these

Q.52 On electrolysis of aqueous solution of Na_2SO_4 using graphite electrode, the product produced at anode is
A. SO_2 B. H_2
●. O_2 D. Na

Q.53 When there is more than one anion present in the electrolyte, the order of increasing discharge ability is
●. $NO_3^- < Cl^{-1} < Br^{-1} < I^{-1} < OH^{-1}$ B. $Cl^{-1} < NO_3^- < Br^{-1} < I^{-1} < OH^{-1}$
C. $OH^{-1} < NO_3^- < Cl^{-1} < Br^{-1} < I^{-1}$ D. $I^{-1} < Cl^{-1} < NO_3^- < Br^{-1} < OH^{-1}$

Q.54 Which one is irreversible cell
●. Dry cell B. Fuel battery
C. Lead storage battery D. All of them

Q.55 Which one of the following is the reduction reaction
●. $Br_2 \rightarrow 2Br^-$ B. $Zn \rightarrow Zn^{+2}$
C. $Fe^{+2} \rightarrow Fe^{+3}$ D. $Sn^{+2} \rightarrow Sn^{+4}$

Q.56 Which of the following is not a constant quantity
●. Single electrode potential B. Standard cell potential
C. Standard electrode potential D. Standard reduction potential

Q.57 The electrode potential of standard hydrogen electrode is chosen as
●. 0 V B. –1 V
C. 1 V D. 2 V

Q.58 Which can replace hydrogen from dilute acids?
A. Au B. Pt
●. Zn D. None of these

Q.59 The standard reduction potential values of three metallic cations X, Y and Z are 0.52, –3.03 and –1.18 respectively. The order of reducing power of the corresponding metal is
●. $Y > Z > X$ B. $X > Y > Z$
C. $Z > Y > X$ D. $Z > X > Y$

Q.60 The difference in electrolysis of concentrated and dilute NaCl is
A. Formation of ions in the solution ●. Product produced at anode
C. Reaction taking place at cathode D. Product produced at cathode

ANSWER KEY

1	D	11	A	21	A	31	B	41	C	51	C
2	D	12	D	22	B	32	B	42	B	52	C
3	D	13	B	23	A	33	D	43	C	53	A
4	B	14	C	24	D	34	B	44	B	54	A
5	A	15	C	25	C	35	B	45	D	55	A
6	B	16	B	26	C	36	C	46	C	56	A
7	A	17	B	27	C	37	D	47	C	57	A
8	B	18	B	28	D	38	C	48	B	58	C
9	B	19	D	29	D	39	C	49	D	59	A
10	B	20	A	30	A	40	B	50	D	60	B

6
UNIT

CHEMICAL BONDING

SELF ASSESSMENT TEST

Q.1 2^{nd} ionization energy of Mg is higher than the first because

A. Metallic character of Mg^{+1} is less than that of Mg

[✓ B. Nuclear pull for Mg^{+1} electrons is more than that for the Mg atom]

C. Size of Mg^{+1} is greater than Mg^{+2}

D. Nature of orbital of Mg^{+1} is different from Mg

Q.2 Arrange following according to correct trend of 1^{st} ionization energies: Na, Mg, A1, P, S

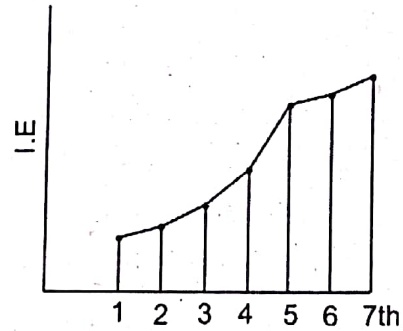
A. Na < Mg < Al < P < S

[✓ B. Na < Al < Mg < S < P]

C. Na < Mg < Al < S < P

D. Na < Al < Mg < P < S

Q.3 Following graph represents successive ionization energies of an element. Choose the valency of element.



[✓ A. 4]

B. 5

C. 6

D. 7

Q.4 Second electron affinity value is always with positive sign. It is due to repulsion of second incoming electron with

A. Cation

[✓ B. Anion]

C. Atom

D. Molecule

Q.5 Which one of the following has maximum electron affinity

A. F

[✓ B. Cl]

C. Br

D. I

Q.6 Octet rule is followed by central atom in

[✓ A. CCl_4]

B. SF_6

C. BF_3

D. PCl_5

Q.7 Orbital around single nucleus is called

[✓ A. Atomic orbital]

B. Molecular orbital

C. Pi orbital

D. Sigma orbital

Q.8 Ionic compounds are obtained by the combination of elements of groups

A. 3 and 5

B. 2 and 5

[✓ C. 1 and 7]

D. 4 and 8

Q.9 Which of the following molecule has non-directional bond(s)

A. NH_3

B. H_2O

[✓ C. NaCl]

D. None of these

Q.10 The bond formed between the atoms having electronegativity difference 1.70 is

A. 50% ionic

B. More than 50% ionic

C. 50% covalent

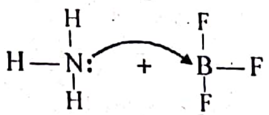
[✓ D. Both A and B]

Q.11 **In a double bond connecting 2 atoms there is a sharing of**
A. 1 electron
B. 3 electrons
C. 2 electrons
●. Two electron pairs

Q.12 **In BF_3 molecule, the B atom makes use of**
A. 2s orbital
●. 2p orbital
C. sp^2-hybrid orbitals
D. 3s orbital

Q.13 **Which of following molecules has all types of bonds except metallic bond**
A. AlF_3
B. NH_4^+
●. PH_4Cl
D. NaCl

Q.14 **Which information is incorrect for compound formed from given structure**



A. N carries positive charge
●. N and B will not complete their octet
C. B carries negative charge
D. NH_3 is donor while BF_3 is accepter

Q.15 **The shape of H_3O^+ is**
A. Tetrahedral
●. Pyramidal
C. Angular
D. Trigonal planar

Q.16 **Total number of valence electrons of nitrogen atom in ammonium ion is**
A. 6
●. 8
C. 10
D. 16

Q.17 **Which one of the following is linear molecule**
A. SO_2
B. C_2H_4
C. H_2S
●. HCN

Q.18 **The molecular geometry of H_2O is**
A. Tetrahedral
B. Linear
●. Bent
D. Both A and B

Q.19 **Lateral overlapping is expected in**
A. Sigma bond
●. Pi bond
C. Metallic bond
D. Ionic bond

Q.20 **Total number of sigma electrons in one molecule of HC ≡ CH**
A. 3
●. 6
C. 4
D. 8

Q.21 **An organic molecule formed by chemical combination of two carbon atoms and four hydrogen atoms have**
A. 6 σ, 0 π
●. 5 σ, 1 π
C. 1 σ, 5 π
D. 4 σ, 2 π

Q.22 **In sp^3 hybridized orbital, the s character is:**
●. 25%
B. 50%
C. 75%
D. 100%

Q.23 **Which of the following molecule is not planer**
A. Benzene
B. Ethene
C. Boron trichloride
●. Phosphorous trichloride

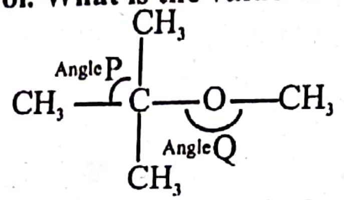
Q.24 **On the basis of s– character which of following overlap results in a practically strongest bond**

A. $sp^2 - sp^2$ [✓ B. $sp - sp$]
C. $sp^3 - sp^3$ D. All have same

Q.25 **The carbon number 2 in the structure $^1CH_2= {}^2CH- {}^3CH= {}^4CH_2$ shows a type of hybridization**

A. sp^3 [✓ B. sp^2]
C. sp D. dsp^2

Q.26 **MTBE is a constituent of petrol. What is the value of angle Q in the molecule MTBE**



A. Angle Q = 90° [✓ B. Angle Q = 105°]
C. Angle Q = 180° D. Angle Q = 360°

Q.27 **Which of following molecule has strongest hydrogen bond**

A. CH_3OH [✓ B. HF]
C. H_2O D. NH_3

Q.28 **Molecule in which the distance between two carbon atom is largest is**

[✓ A. Ethane] B. Ethyne
C. Ethene D. Benzene

Q.29 **Which of the following is weakest bond**

A. H – H B. C – C
C. N – N [✓ D. F – F]

Q.30 **The nature of bonds and molecule of CO_2 is____and ____ respectively.**

A. Polar, Polar [✓ B. Polar, Non-Polar]
C. Non-Polar, Non-Polar D. Non-Polar, Polar

Q.31 **The carbon-hydrogen bond length is shortest in**

A. Ethane B. Ethene
[✓ C. Ethyne] D. Methane

Q.32 **Following information are true for which of the following group**
(i) Have LDF due to non-polar nature
(ii) All exist in gaseous state at ordinary temperature
(iii) Size and polarizability increase down the group
(iv) Boiling point increases down the group

A. IIA B. VIIA
C. VA [✓ D. VIIIA]

Q.33 **From the following, select one which can conduct electricity in solid as will as in liquid state**

A. Magnesium oxide B. Phosphorous
[✓ C. Zinc] D. Silicon dioxide

Q.34 **Intermolecular forces present in ionic compounds are due to**

A. Metallic bonds B. Hydrogen bonds
[✓ C. Electrostatic attractions] D. Electron pair bonds

Q.35 **Debye forces present in**

A. HCl and H_2O B. Na^+ and H_2O
[✓ C. Cl_2 and HCl] D. Solid I_2

Q.36 A specie with dipole moment

[✓ A. Cis-1,2-dichloroethene] B. Benzene

C. $BeCl_2$ D. Trans-1,2-dichloroethene

Q.37 In which of the following bond pair-bond pair angle is minimum

A. Water B. Ammonia

[✓ C. Hydrogen sulphide] D. Nitrogen tri fluoride

Q.38 First electron affinity is maximum for

A. Fluorine B. Iodine

[✓ C. Chlorine] D. Bromine

Q.39 The shape of NH_2^- is

A. Linear [✓ B. Angular]

C. Pyramidal D. Tetrahedral

Q.40 Which group of periodic table shows generally abnormal trends in ionization energy

A. IIA and VIA [✓ B. IIIA and VIA]

C. IIA and VA D. VIII

Q.41 A specie with maximum percentage of co-ordinate covalent character in any individual bond

A. NH_4^+ [✓ B. H_3O^+]

C. PH_4^+ D. BF_4^-

Q.42 Which one of the following has maximum bond angle

A. CCl_4 B. NF_3

C. NH_3 [✓ D. CO_2]

Q.43 A molecule which does not have zero dipole moment

[✓ A. CO] B. Ethene

C. BF_3 D. Trans 2–butene

Q.44 A compound which is most ionic in nature

A. KCl B. KF

C. NaCl [✓ D. RbF]

Q.45 In which of the following molecules all bonds are polar but molecule is non-polar

A. H_2O B. CH_3OH

[✓ C. CCl_4] D. Cl_2

Q.46 Which of the followings have maximum bond energy

A. F_2 [✓ B. Cl_2]

C. Br_2 D. I_2

Q.47 All of the following pairs have same shapes except

[✓ A. SO_2 and $AlCl_3$]
B. NH_4^{+1} and $SiCl_4$
C. NH_2^{-1} and H_2O
D. NH_3 and PH_3

Q.48 Type of hybridization of carbons in 1,2-butadiene

A. sp^3
B. sp^2
C. sp
[✓ D. All of these]

Q.49 Maximum ionic character is exhibited by

A. NaCl
[✓ B. CsF]
C. KCl
D. HF

Q.50 Atomic radius can be determined with the help of

A. X-rays
B. Spectroscopy
C. Polarimeter
[✓ D. Both A. and B.]

Q.51 The percentage of s-character in hybrid of nitrogen in ammonia

[✓ A. 25% s-character]
B. 33.4% s-character
C. 50% s-character
D. 75% s-character

Q.52 Structure of $SnCl_2$ is

A. Tetrahedral
B. Linear
[✓ C. Bent]
D. Trigonal

Q.53 Which statement is not true for VBT

A. Atomic orbital after overlapping do not loose their identity
B. Only valence shell orbitals (un-paired) overlap
[✓ C. O_2 show paramagnetic behaviour]
D. Number of covalent bonds between two atoms is equal to number of un-paired electrons

Q.54 Number of bonds in N_2 molecule is/are

A. One sigma and one pi
B. Two sigma and one pi
C. Two sigma only
[✓ D. One sigma and two pi]

Q.55 All of the following have almost similar bond angle except one

A. BF_3
B. $AlCl_3$
[✓ C. NH_3]
D. C_2H_4

Q.56 2nd IE is always endothermic and greater than that of first IE due to______

A. Greater nuclear charge
B. Removal from Cation
C. Electronic repulsion
[✓ D. Both A and C]

Q.57 2nd and 3rd EA are always ____________

A. Exothermic
[✓ B. Endothermic]
C. May be endothermic or exothermic
D. None of these

Q.58 **Electronegativity is highest for which of the following group**

A. IA B. IIA

[✓ C. VIIA] D. VIIIA

Q.59 **__________ pair of group forms stronger ionic bond**

A. IA &VIIIA [✓ B. IA & VIIA]

C. IIA & VIIA D. IIA & VIA

Q.60 **Which of the following bond is most polar in nature?**

A. H-H B. N-F

[✓ C. H-F] D. C-F

ANSWER KEY

1	B	11	D	21	B	31	C	41	B	51	A
2	B	12	B	22	A	32	D	42	D	52	C
3	A	13	C	23	D	33	C	43	A	53	C
4	B	14	B	24	B	34	C	44	D	54	D
5	B	15	B	25	B	35	C	45	C	55	C
6	A	16	B	26	B	36	A	46	B	56	D
7	A	17	D	27	B	37	C	47	A	57	B
8	C	18	C	28	A	38	C	48	D	58	C
9	C	19	B	29	D	39	B	49	B	59	B
10	D	20	B	30	B	40	B	50	D	60	C

7 UNIT

s AND p BLOCK ELEMENTS AND TRANSITION ELEMENTS

SELF ASSESSMENT TEST

Q.1 Elements in the same vertical group of the periodic table have same
[✓ A. Number of valence electrons] B. Atomic number
C. Atomic mass D. Atomic volume

Q.2 Which of the following sets of elements belongs to third period?
A. Cl, Br, Ar [✓ B. Mg, Cl, Ar]
C. S, Al, Ne D. Ca, Si, Cl

Q.3 The elements in which d orbitals are in the process of completion are
[✓ A. Outer transition elements] B. Inner transition elements
C. Normal elements D. Representative elements

Q.4 The first transition series ends on the element
A. Scandium [✓ B. Zinc]
C. Calcium D. Mercury

Q.5 Cr and Cu have half-filled s-orbitals why
A. They belong to p-block elements [✓ B. They give stablity to d-orbitals]
C. They belong to 4d- series D. They all diamagnetic

Q.6 Which of the following pairs show resemblance in their valance shell electronic configuration
[✓ A. Sc, Y] B. Mn, Mo
C. Zn, V D. Pt, Au

Q.7 Which of the following has the maximum number of unpaired electrons
A. Ni^{2+} B. V^{3+}
C. Ti^{3+} [✓ D. Fe^{2+}]

Q.8 Shielding effect across the period
A. Increases B. Decreases
C. Cannot be predicted [✓ D. Remains constant]

Q.9 Which one of the following transition element shows only single restricted oxidation state
A. Mn B. Co
[✓ C. Zn] D. Ni

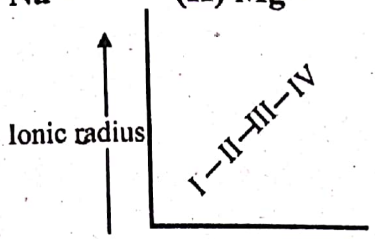
Q.10 Which of the following cation has smallest size
[✓ A. Al^{+3}] B. Ca^{+2}
C. Mg^{+2} D. Na^{+1}

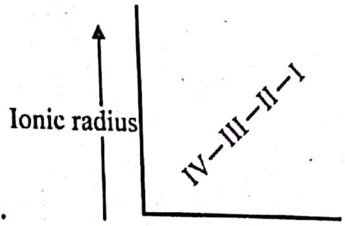
Q.11 Which of the following is a favourable factor for cation formation
A. High electron affinity B. Small atomic size
C. High electronegativity [✓ D. Low ionization potential]

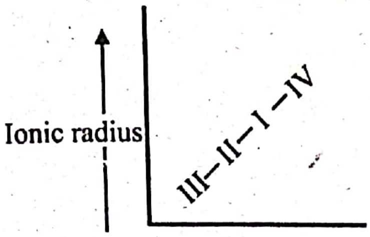
Q.12 The addition of an electron in valence shell of an isolated gaseous atom to form uni-negative ion is ______ process
[✓ A. Exothermic only] B. Endothermic only
C. Enthalpy change is zero D. Exothermic or endothermic

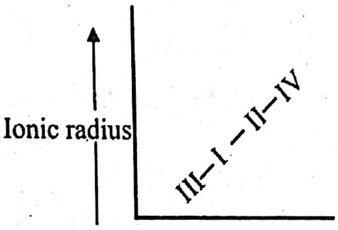
Q.13 Mark the correct statement
[✓ A. Na+ is smaller than Na atom] B. Na+ is larger than Na atom
C. Cl^- is smaller than Cl atom D. Cl^- and Cl are of equal size

Q.14 **Isoelectronic species contain same number of e$^-$ which among the following is the correct order for ionic radius**
(I) Na^{+1} (II) Mg^{+2} (III) Al^{+3} (IV) Si^{+4}

A.


[✓ B.]


C.


D.


Q.15 **Which one of the following has lowest melting point**
A. Be
B. Ca
C. Ba
[✓ D.] Mg

Q.16 **Which of the following information is obtained from melting point and boiling point of an element?**
A. Strength between molecules
B. Physical state at room temperature
C. Strength between atoms
[✓ D.] All of these above

Q.17 **The highest melting point is associated with which of following?**
A. Coke
[✓ B.] Diamond
C. Graphite
D. Charcoal

Q.18 **Melting point of group I-A down the group**
A. Increases
[✓ B.] Decreases
C. Remains constant
D. Not regular

Q.19 **Mark the correct order with respect to the melting/boiling points**
A. Na > K
B. I > Br
C. Kr > Ne
[✓ D.] All of the above are correct

Q.20 **Among halogens, the highest boiling point is of**
A. Fluorine
B. Chlorine
C. Bromine
[✓ D.] Iodine

Q.21 **For the molecular forms of the given elements: P, S, Cl, Ar The correct decreasing order for their melting and boiling points is**
A. Ar > P > Cl > S
[✓ B.] S > P > Cl > Ar
C. Cl > P > S > Ar
D. P > S > Cl > Ar

Q.22 **The ionization energy of boron is less than that of beryllium because**
A. Atomic size of B > Be
B. Atomic size of B < Be
C. Shielding effect of B < Be
[✓ D.] Removal of e$^-$ from p-subshell

Q.23 **2nd ionization energy of Mg is higher than the first because**
A. Metallic character of Mg^{+1} is less than that of Mg
[✓ B.] Nuclear pull for Mg^{+1} electrons is more than that for the Mg atom
C. Size of Mg is less than Mg^{+1}
D. All of the above

Q.24 The maximum first ionization energy is possessed by
A. Mg
B. Si
C. Al
●. Cl

Q.25 All of the following give colorless complex except
A. Zn^{+2}
B. Ti^{+4}
C. Sc^{+3}
●. Mn^{+2}

Q.26 Amongst the following elements whose configurations are given below, the one having the highest ionization energy is
A. $[Ne]3s^2\,4p^4$
B. $[Ne]3s^2\,3p^2$
C. $[Ne]3s^2\,3p^1$
●. $[Ne]3s^2\,3p^3$

Q.27 The first ionization energy of magnesium is 738kJ/mol and the 2nd I.E of magnesium will be
A. Equal to 738kJ/mol
B. Less than 738kJ/mol
●. Higher than 738kJ/mol
D. Equal to 738cal/mol

Q.28 Incorrect 1st ionization energy order is
A. N > O
B. Be > B
●. F > Ne
D. He > H

Q.29 The ionization energy of nitrogen is more than that of oxygen because of
A. The greater attraction of the electrons by the nucleus
●. The extra stability of the half-filled p-orbitals
C. The smaller size of nitrogen
D. High nuclear charge

Q.30 Which of the following configurations is associated with largest difference between 2nd and 3rd ionization energy
A. $1s^2\,2s^2\,2p^2$
B. $1s^2\,2s^2\,2p^6\,3s^2$
C. $1s^2\,2s^2\,2p^6\,3s^1$
D. $1s^2\,2s^2\,2p^1$

Q.31 Which of the following configurations corresponds to alkaline earth metals
A. $[Ar]\,3d^{10}, 4s^2$
B. $[Ne]3d^2, 3p^2$
●. $[Ar]4s^2$
D. $[Ar]3d^{10}, 4s^1$

Q.32 Which of the following is the strongest alkali?
A. NaOH
●. CsOH
C. $Ca(OH)_2$
D. KOH

Q.33 The reactivity of oxides of alkaline earth metals ________ down to the group
●. Increase
B. Unpredictable
C. Decrease
D. Remains constant

Q.34 Which of the following alkaline earth metal is very least reactive
A. Mg
●. Be
C. Ba
D. Ca

Q.35 The milk of magnesia is used for the treatment of
●. Acidity
B. Basicity
C. Rancidity
D. Jaundice

Q.36 The solubility of alkaline earth metal hydroxide increases down the group due to
●. Decrease in lattice energy
B. Increase in lattice energy
C. Increase in charge to size ratio of cations
D. Constant charge to size ratio of cations in the group

Q.37 Soda-lime is a mixture of

A. $Ca(OH)_2 + H_2O$
B. $Mg(OH)_2 + Ca(OH)_2$
[✓ C. $CaO + NaOH$]
D. $MgO + NaOH$

Q.38 Correct order of solubility in water for alkaline earth metal oxides is

[✓ A. $MgO < CaO < SrO < BaO$]
B. $MgO < BaO < CaO < SrO$
C. $CaO < MgO < BaO < SrO$
D. $SrO < CaO < BaO < MgO$

Q.39 Which of the following produces water not only reacting with caustic soda but also with oil of vitriol

A. CaO
B. BaO
[✓ C. BeO]
D. MgO

Q.40 The minor product formed by burning of magnesium ribbon in pure air will be

A. MgO
[✓ B. Mg_3N_2]
C. MgS
D. None of these

Q.41 For alkaline earth metals the correct order of reaction with cold water is

[✓ A. Mg > Be]
B. Ca > Sr
C. Sr > Ba
D. Be > Ba

Q.42 The oxidation number of central metal atom in $K_3[Fe(CN)_6]$ is

A. 0
[✓ B. +3]
C. +2
D. +4

Q.43 The oxidation state of Cr in CrO_2Cl_2 is

A. 2
B. 4
C. 3
[✓ D. 6]

Q.44 Which of the following transition element used as a catalyst in Haber's process

[✓ A. Fe]
B. Al_2O_3
C. Cr_2O_3
D. All of these

Q.45 The catalytic activity of transition elements is usually due to two main reasons, which are

[✓ A. They have several different oxidation state and they provide a site at which reaction taken place]
B. They forms compound and show colours
C. They have Variable oxidation states and show colours
D. None of these

Q.46 Which economical catalyst is used in preparation of sulphuric acid

A. Pt
B. Ni
[✓ C. V_2O_5]
D. All of these

Q.47 For d^2sp^3 hybridization, the expected shape is

A. Tetrahedral
B. Trigonal bipyramidal
C. Square planar
[✓ D. Octahedral]

Q.48 Co-ordination number of the transition element in $[Pt\ Cl\ NO_2 (NH_3)_4]^{2-}$ is

A. 2
[✓ B. 6]
C. 4
D. 8

Q.49 The central atom along with ligands is called

A. Complex ion
[✓ B. Coordination sphere]
C. Ligand
D. Complex compound

Q.50 Ethylenediamine is a

A. Monodentate Ligand
[✓ B. Hexadentate ligand]
C. Bidentate Ligand
D. Tridentate ligand

Q.51 Geometry of the complex compounds usually depends upon

A. Nature of ligand
B. Types of hybridization in the elements of ligands
C. Hybridization of central metal
[✓ D. Both A. and B.]

Q.52 Which one of the following is a neutral mono dentate ligand

A. N_2H_4
B. OH^-
[✓ C. CO]
D. $C_2O_4^{2-}$

Q.53 Transition metals form complexes very readily, the reason is

A. Smaller cations
B. Greater charge density of cations
C. Vacant d-orbitals
[✓ D. All of them]

Q.54 The IUPAC name of $[Co(NH_3)_4Cl_2]Cl$ is

A. Tetraamminedichloro cobalt (I) chloride
B. Dichloro tetraamine cobalt (II) chloride
[✓ C. Tetraamminedichloro cobalt (III) chloride]
D. Dichloro tetraamine cobalt (III) chloride

Q.55 The tendency of 3d metal ions to form stable complexes is due to

A. Strong electronegative nature
B. Variable valency
C. Very low ionization energies
[✓ D. High charge/radius ratio and vacant d orbitals]

Q.56 The aqueous solution containing which one of the following ions will be colourless

[✓ A. Sc^{3+}]
B. Fe^{+2}
C. Fe^{+3}
D. Mn^{+2}

Q.57 The colour of the $[Ti(H_2O)_6]^{3+}$ is

A. Red
B. Pink
C. Orange
[✓ D. Violet]

Q.58 **From the following which ion gives colourless complex**

A. Mn^{2+} B. Cu^{2+}

●. Cu^{1+} D. Fe^{3+}

Q.59 **In $[Ti(H_2O)_6]^{3+}$, yellow light is absorbed the solution of $[Ti(H_2O)_6]^{3+}$ ion look violet in colour. The transmitted lights are __________**

●. Blue, red B. Violet, yellow

C. Green, red D. Violet, red

Q.60 **Which one of the following has highest ionization energy**

A. Fluorine B. Oxygen

C. Nitrogen ●. Helium

ANSWER KEY

1	A	11	D	21	B	31	C	41	A	51	D
2	B	12	A	22	D	32	B	42	B	52	C
3	A	13	A	23	B	33	A	43	D	53	D
4	B	14	B	24	D	34	B	44	A	54	C
5	B	15	D	25	D	35	A	45	A	55	D
6	A	16	D	26	D	36	A	46	C	56	A
7	D	17	B	27	C	37	C	47	D	57	D
8	D	18	B	28	C	38	A	48	B	58	C
9	C	19	D	29	B	39	C	49	B	59	A
10	A	20	D	30	B	40	B	50	B	60	D

8 UNIT

FUNDAMENTAL CONCEPTS OF ORGANIC CHEMISTRY AND CHEMISTRY OF HYDROCARBONS

SELF ASSESSMENT TEST

Q.1 Which of the following option is not true regarding thiophene
A. Heterocyclic
B. Aromatic
[✓ C. Alicyclic]
D. Monocyclic

Q.2 _______ is heterocyclic compound
A. Toluene
[✓ B. Furan]
C. Phenol
D. Anthracene

Q.3 Which condition can be used for hydrogenation of ethene
A. Pt / Pd, 25°C, 1atm
B. Ni, 250°C, 1-5atm
C. Raney Ni, 100°C, 3atm
[✓ D. All of these]

Q.4 Maximum number of hydrogen atoms are in
A. Cyclobutane
[✓ B. Cyclohexane]
C. Cyclopentane
D. Benzene

Q.5 Which is not true about the compound 1,3-Cyclohexadiene
A. Non-benzenoid
B. Carbocyclic
C. Non-aromatic
[✓ D. Heterocyclic]

Q.6 Benzene is _______ compound
A. Heterocyclic
B. Alicyclic
C. Aliphatic
[✓ D. Aromatic]

Q.7 In t-butyl alcohol the tertiary carbon is bonded to
A. Two hydrogen atoms
B. Three hydrogen atoms
C. One hydrogen atoms
[✓ D. No hydrogen atoms]

Q.8 CH_3CH_2SH contains which functional group
[✓ A. Marcapto]
B. Cyano
C. Acid halide
D. Amino

Q.9 Which one is aromatic hydrocarbon
A. Thiophene
B. Phenol
[✓ C. Toluene]
D. Cyclohexane

Q.10 Which one is not meta directing group
[✓ A. $-OCOCH_3$]
B. $-CCl_3$
C. $-COOCH_3$
D. $-NO_2$

Q.11 Ethyne on treatment with HBr finally give
A. 1, 2-dibromoethane
[✓ B. 1,1-dibromoethane]
C. 1,2-dibromoethene
D. 1,1-dibromoethene

Q.12 The higher hydrocarbons are used in cracking are mostly consisted of
A. Propene
B. Benzene
C. Butane
[✓ D. Kerosene]

Q.13 Which of the following statements is incorrect about cracking of petroleum
(i) Both heat and air is required.
(ii) Lower alkenes are obtained in all types of cracking
(iii) Higher hydrocarbons in vapour phase are mixed with air in steam cracking
(iv) High octane petrol is obtained in thermal cracking
A. (i) and (ii)
[✓ B. (i), (iii) and (iv)]
C. (ii) and (iii)
D. (i), (ii), (iii) and (iv)

Q.14 Select nucleophile from the following
A. NO_2
[✓ B. NH_3]
C. NO_2^+
D. NH_4^+

Q.15 Select the incorrect statement
A. An ion with a positively charged carbon atom is called a carbocation.
B. When organic compounds react, their bonds can split in either of two ways, by heterolytic or homolytic fission.
[✓ C. Negative ions and compounds in which an atom has an unshared pair of electrons are electrophilic in nature]
D. A reagent which attacks a region where the electron density is high is called an electrophile

Q.16 Most stable carbocation is
[✓ A. Tertiary]
B. Primary
C. Secondary
D. Methyl

Q.17 Which one of the following is called free radical
A. Cl^+
B. Cl^-
[✓ C. $Cl^\bullet$]
D. Cl_2

Q.18 Which type of isomerism is shown by the following compounds:
$CH_3CH_2—O—CH_2CH_3$ and $CH_3CH_2CH_2—OCH_3$
A. Chain isomerism
B. Position isomerism
[✓ C. Metamerism]
D. Functional group isomerism

Q.19 The structures of three compounds are shown:
I-$CH_3CH_2—O—CH_3$ and II-$CH_3CH_2CH_2—OH$ and III-$CH_3CH(OH)CH_3$
Which compounds are isomers of each other?
A. 1st and 2nd only
B. 2nd and 3rd only
C. 1st and 3rd only
[✓ D. All are isomers of one another]

Q.20 Chain isomerism is also called:
A. Metamerism
[✓ B. Skeletal isomerism]
C. Tautomerism
D. All of these

Q.21 Diethyl ketone and Methyl n-propyl ketone are:
[✓ A. Metameric isomers]
B. Cis trans isomers
C. Positional isomers
D. None of these

Q.22 Which statement is incorrect about cis-trans isomerism
A. Two carbon atoms with double bond cannot rotate freely
B. Two compounds that possess the same structural formula but differ with respect to the positions of identical groups in space.
C. In cis form, similar groups lie on same side of double bond
[✓ D. Two groups attached to same carbon atom must be same]

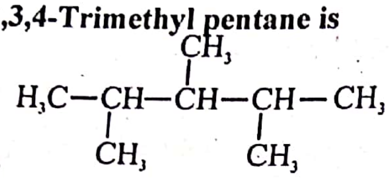
Q.23 1-Chloropropene and 2-Chloropropene show isomerism
A. cis-trans
B. Functional group isomerism
[✓ C. Position isomerism]
D. Chain isomerism

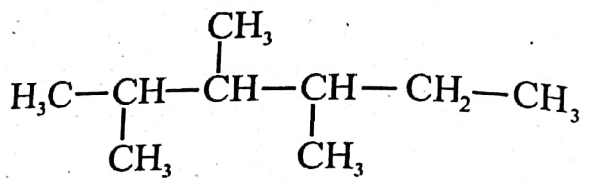
Q.24 Which statement about the members of a homologous series is correct:
[✓ A. They have the same empirical formula]
B. They have same melting points
C. They have the same number of carbon atoms per molecule
D. They do not undergo similar reactions

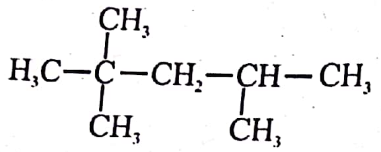
Q.25 The IUPAC name of $CH_3-CH(C_2H_5)-CH_2-C(CH_3)_2-CH_3$

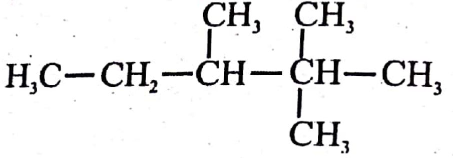
A. 2,2-Dimethyl 4-ethyl pentane
B. 2,2-Dimethyl heptane
C. Nonane
●. 2,2, 4–Trimethyl hexane

Q.26 2,3,4-Trimethyl pentane is

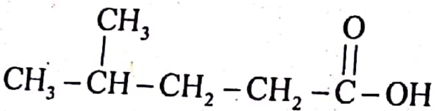
●.

$H_3C-\underset{CH_3}{CH}-\overset{CH_3}{CH}-\underset{CH_3}{CH}-CH_3$

B.

$H_3C-\underset{CH_3}{CH}-\overset{CH_3}{CH}-\underset{CH_3}{CH}-CH_2-CH_3$

C.

$H_3C-\underset{CH_3}{\overset{CH_3}{C}}-CH_2-\underset{CH_3}{CH}-CH_3$

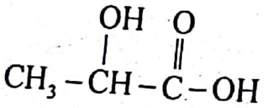
D.

$H_3C-CH_2-\overset{CH_3}{CH}-\underset{CH_3}{\overset{CH_3}{CH}}-CH_3$

Q.27 Which one of the following names is correct for the structure


$CH_3-\overset{CH_3}{CH}-CH_2-CH_2-\overset{\underset{||}{O}}{C}-OH$

A. 2–Methyl pentanoic acid
B. Methyl pentanoic acid
●. 4–Methyl pentanoic acid
D. 4, 4-Dimethyl butanoic acid

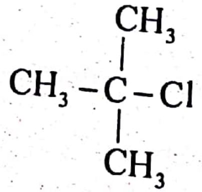
Q.28 Which one of the following is the name of given structure

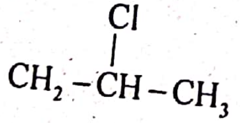

$CH_3-\overset{OH}{CH}-\overset{\underset{||}{O}}{C}-OH$

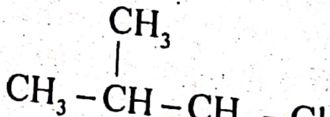
A. Maleic acid
●. Lactic acid
C. Malonic acid
D. Propanal

Q.29 Which one of the following structures is secondary alkyl halide

A. CH_3-CH_2-Cl

B.

$CH_3-\underset{CH_3}{\overset{CH_3}{C}}-Cl$

●.

$CH_2-\overset{Cl}{CH}-CH_3$

D.

$CH_3-\overset{CH_3}{CH}-CH_2-Cl$

Q.30 While selecting longest possible chains among the organic compounds for nomenclature, when two or more chains compete each other, which one is selected:

A. Chain with less substituents
●. Chain with greater number of substituents
C. Chain near to double bond
D. Chain near to triple bond

Q.31 Incomplete combustion (occurs in limited supply of air) results in formation of H_2O and

A. CO
B. CO_2
C. C
●. C and CO

Q.32 The standard amount of heat released when 1 mole of CH_4 is burnt in excess of air is

●. 891kJ/mole
B. 445
C. 1336.5kJ/mole
D. 1782kJ/mole

Q.33 When one mole of ________ is burnt completely in excess of oxygen, produces 2 moles of water

A. Propane
B. Acetylene
C. Benzene
●. Methane

Q.34 The order of reactivity of halogens with alkanes is in the order of

A. $I_2 > F_2 > Cl_2 > Br_2$
B. $I_2 > Cl_2 > Br_2 > F$
C. $I_2 > Br_2 > Cl_2 > F_2$
●. $I_2 < Br_2 < Cl_2 < F_2$

Q.35 Select the option that represents propagation step during bromination of alkane in presence of sun light

A. $R-R+Br_2 \longrightarrow R-CH_2-Br+HBr$
B. $\dot{B}r+\dot{B}r \longrightarrow \dot{B}r_2$
● $R-\dot{C}H_2+Br_2 \longrightarrow R-CH_2Br+\dot{B}r$
D. $\dot{R}+\dot{R} \longrightarrow R-R$

Q.36 The direct substitution is not possible with ________ is treated when alkane in presence of sun light

A. Cl_2
●. I_2
C. Br_2
D. F_2

Q.37 The dehydrating agents that can be used for alcohol dehydration:

A. Conc. H_2SO_4
B. H_3PO_4 and P_4O_{10}
C. Al_2O_3
●. All of these

Q.38 The alcohol which can be easily dehydrated is:

A. $(CH_3)_2CHOH$
B. CH_3CH_2OH
● $(CH_3)_3COH$
D. Alcohols do not show dehydration

Q.39 2-Bromobutane reacts with alcoholic KOH to give:

A. 1-Butene
B. 1-Butanol
● 2-Butene
D. 2-Butanol

Q.40 One mole of a hydrocarbon X reacts completely with one mole of hydrogen gas in the presence of a heated catalyst. What could be the formula of X?

A. C_2H_6
B. C_3H_8
● C_5H_{10}
D. C_7H_{16}

Q.41 Baeyer's reagent is

●. 1% Cold alkaline $KMnO_4$
B. 1% hot acidified potassium dichromate
C. $(R)_3Al$ and $TiCl_4$
D. Liquid ammonia

Q.42 Alkenes undergo

● Addition polymerization
B. Condensation polymerization
C. Addition elimination polymerization
D. Both "B" and "C"

Q.43 Which of the following set cannot be used for dehydration of alcohols

A. $AlCl_3$, P_2O_3
B. H_2SO_4, H_3PO_4
C. H_2SO_4, P_2O_5
● $CaCl_2$, Silica gel

Q.44 The oxidative cleavage of double bond in 2-pentene in the presence of hot alkaline $KMnO_4$ produces

●. Formic acid
B. Acetic acid
C. Formic acid and acetic acid
D. Acetic acid and propanoic acid

Q.45 Polymerization of ethene to polyethene takes place in the presence of

A. $(C_2H_5)_4Pb$
B. $(CH_3)_4Pb$ and $TiCl_4$
●. $Al(C_2H_5)_3$ and $TiCl_4$
D. Zn/HCl

Q.46 Ethene gas is absorbed by conc. H_2SO_4 to form an intermediate, which when hydrolysed with boiling water forms

A. Methyl alcohol
B. Formic acid
● Ethyl alcohol
D. Methyl hydrogen sulphate

Q.47 Raney nickel is prepared from ——— by treating with caustic soda

A. Ni-Cu alloy
B. Ni-Fe alloy
● Ni-Al alloy
D. Ni-Mg alloy

Q.48 The resonance energy of benzene is

A. 136 kcal/mole
B. -160.5 kJ/mole
●. 150.5 kJ/mole
D. Both (A. and (B.

Q.49 The C–C bond length in benzene is

A. Less than alkyne
B. More than alkane
C. Less than alkene
●. Less than alkane

Q.50 Total number of sigma bonds in benzene molecule are:

A. 6
●. 12
C. 3
D. 9

Q.51 According to modern concept benzene has

A. Three double bond
B. Two double bonds
●. Delocalized π electron charge
D. One double bond

Q.52 The reaction in which there is an introduction of _________ in benzene is classified in acylation:

A. $-CH_3$
B. –HCO
● H_3C-CO
D. –COOH

Q.53 Replacement of hydrogen of benzene by alkyl group in the presence of alkyl halide and aluminum chloride is known as

A. Dow's process
B. Friedel and Craft acylation
● Friedel and Craft alkylation
D. Clemmenson reduction

Q.54 In the nitration of benzene with conc. HNO_3 + conc. H_2SO_4, the active species involved is known as

A. Nitrite ion
B. Nitrate ion
C. Nitrosonium ion
●. Nitronium ion

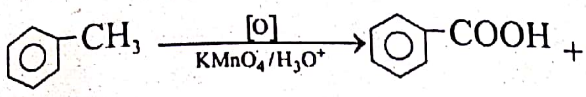
Q.55 Which of the following can be used as catalyst for the saturation of benzene?

A. Ag
●. Pt/H_3O^+
C. $AlCl_3$
D. P_2O_5

Q.56 Benzene can be converted into cyclohexane ring by

●. Reduction
B. Unsaturation
C. Oxidation
D. Neutralization

Q.57



+ X, X is

●. H_2O B. $H_2O + CO + CO_2$

C. $H_2O + CO_2$ D. $H_2O + C + CO + CO_2$

Q.58 **Ethyl benzene undergoes ________ when acidified $KMnO_4$ is made to react to form benzoic acid:**

A. Reduction ●. Oxidation

C. Hydroxylation D. Hydrogenation

Q.59 **The Friedel craft reaction will be slowest for**

A. Benzene B. Toluene

●. Nitrobenzene D. Phenol

Q.60 **The major product of nitration of benzoic acid?**

●. 3-Nitrobenzoic acid B. 4-Nitrobenzoic acid

C. 2-Nitrobenzoic acid D. 2,4-Dinitrobenzoic acid

ANSWER KEY

1	C	11	B	21	A	31	D	41	A	51	C
2	B	12	D	22	D	32	A	42	A	52	C
3	D	13	B	23	C	33	D	43	D	53	C
4	B	14	B	24	A	34	D	44	A	54	D
5	D	15	C	25	D	35	C	45	C	55	B
6	D	16	A	26	A	36	B	46	C	56	A
7	D	17	C	27	C	37	D	47	C	57	A
8	A	18	C	28	B	38	C	48	C	58	B
9	C	19	D	29	C	39	C	49	D	59	C
10	A	20	B	30	B	40	C	50	B	60	A

9 UNIT

ALKYL HALIDES, ALCOHOLS AND PHENOLS & ALDEHYDES AND KETONES

SELF ASSESSMENT TEST

Q.1 **$CH_3 - CH(Cl)CH_3$ is called as**

A. Iso-propyl chloride
B. 2°-Alkyl halide
C. 2-Chloropropane
[✓ D. All are correct]

Q.2 **Halogens present in halothanes are**

A. F, I, Br
B. F, At
[✓ C. F, Cl, Br]
D. Cl, I

Q.3 **Which of the following statement is incorrect**

A. Halothane is the only inhalational anesthetic having bromine atom
[✓ B. CFC's destroy ozone layer in troposphere]
C. Carbon tetrachloride is used as fire extinguisher
D. Both A and C are incorrect

Q.4 **Which one of the following species is not an electrophile?**

[✓ A. NH_3]
B. Br^+
C. H^+
D. BF_3

Q.5 **The alkyl halide molecule on which the nucleophile attacks is called:**

A. Electrophile
B. Leaving group
[✓ C. Substrate]
D. Electrophilic centre

Q.6 **Primary alkyl halides give**

[✓ A. E2 and S_N2 reactions]
B. E1 and S_N1 reactions
C. Either E1 or E2 reactions
D. S_N2 and E1 reactions

Q.7 **Most stable carbonium ion is**

A. $(CH_3)_3 - C - {}^+CH_2$
B. ${}^+CH_3$
[✓ C. $(CH_3)_3 - C^+$]
D. $CH_3 - {}^+CH - CH_3$

Q.8 **If an electrophile is the attacking reagent which one is most reactive?**

A. R - I
B. R - Cl
C. R - Br
[✓ D. R - F]

Q.9 **SN1 reactions are favoured in which solvent?**

A. Non polar
[✓ B. Polar]
C. Slightly polar
D. All solvents

Q.10 **Which pair of reactant give the primary alkyl amine as a product**

A. $C_2H_5Br + CH_3\bar{O}$
B. $C_2H_5Br + C\bar{N}$
C. $C_2H_5Br + 2[H]$
[✓ D. $C_2H_5Br + NH_3$]

Q.11 **Which one among the following is good leaving group**

A. $O\bar{H}$
B. $\bar{F}$
C. $C\bar{\ell}$
[✓ D. I^-]

Q.12 In SN reactions, the correct order of reactivity of alkyl halide is

A. 1° > 2° > 3°
●. 3° > 2° > 1°
C. 2° > 1° > 3°
D. 1° > 3° > 2

Q.13 C – X bond is strongest in

●. CH_3-F
B. CH_3-Cl
C. CH_3-Br
D. CH_3-I

Q.14 Among halide (X^-) ions, the poor leaving group is

●. F^-
B. Cl^-
C. Br^-
D. I^-

Q.15 Which of the following mechanism is most likely to be affected by nature of leaving group

A. $SN_2 + SN_1$
B. $E_2 + E_1$
●. $SN_1 + E_1$
D. $SN_2 + E_2$

Q.16 The reactivity order of alkyl halides for Dehydrohalogenation reaction is

A. $R-Cl > R-Br > R-F > R-I$
B. $R-F > R-Cl > R-Br > R-I$
●. $R-I > R-Br > R-Cl > R-F$
D. $R-Br > R-Cl > R-I > R-F$

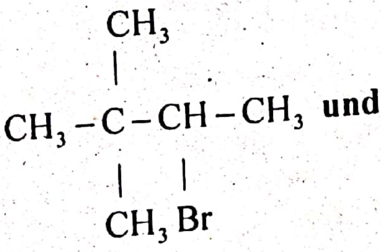
Q.17 2-Bromopropane on reaction with alcoholic KOH gives

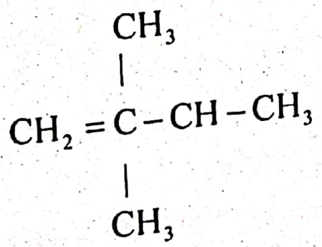
A. 2-Propanol
B. Propane
●. 1-Propene
D. 1-Propanol

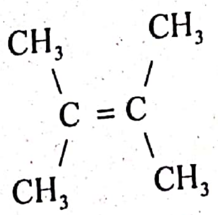
Q.18 Rate = k [R – X][Base]

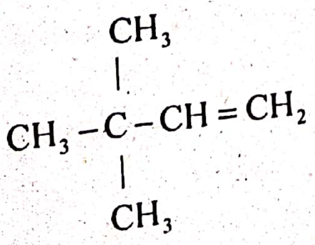
This rate law is consistent with which of following mechanism

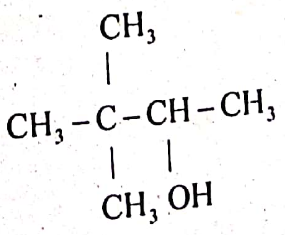
A. SN1
B. SN2
C. E1
●. E2

Q.19 
$CH_3-\overset{CH_3}{\underset{CH_3}{C}}-\underset{Br}{CH}-CH_3$ **undergoes E mechanism to produce.**

A. 
$CH_2=\overset{CH_3}{\underset{CH_3}{C}}-CH-CH_3$

B. 

●. 
$CH_3-\overset{CH_3}{\underset{CH_3}{C}}-CH=CH_2$

D. 
$CH_3-\overset{CH_3}{\underset{CH_3}{C}}-\underset{OH}{CH}-CH_3$

Q.20 Alkaline hydrolysis of CH_3–Cl follows which mechanism and what will be the product

A. SN1, CH_3-OH
B. SN_2, CH_3-CH_2-OH
●. SN2, CH_3-OH
D. E2, CH_3-OH

Q.21 Neo-pentyl alcohol is a type of alcohol
[✓ Primary alcohol]
B. Tertiary alcohol
C. Secondary alcohol
D. Aromatic alcohol

Q.22 The hydration of ethene in the presence of conc. H_2SO_4 or conc. H_3PO_4 produces
[✓ Ethanol]
B. Ethanal
C. Ethane
D. Ethyne

Q.23 Ethyl hydrogen sulphate undergoes ________ to form ethanol
A. Hydration
[✓ Hydrolysis]
C. Both A and B
D. Oxidation

Q.24 For the reaction $H_3C-CH_2-OH \xrightarrow[180°C]{H^+} H_2C=CH_2+H_2O$, The type of bonds that break are
A. C – H and C – H
B. C – H and H – O
C. C – O and C – O
[✓ C – H and C – O]

Q.25 2-Propanol upon oxidation with acidified dichromate gives:
A. Acetaldehyde
[✓ Acetone]
C. 2-Methylpropene
D. All of these

Q.26 When ethanol reacts with PCl_5 then products formed are:
A. C_2H_5Cl and H_3PO_3
B. C_2H_5Cl and HCl
[✓ C_2H_5Cl, $POCl_3$ and HCl]
D. C_2H_5Cl only

Q.27 When an unknown primary alcohol gives yellow precipitates of iodoform, it is most likely to be:
A. Methanol
[✓ Ethanol]
C. 1-Propanol
D. 1-Butanol

Q.28 Distinction between methanol and ethanol can be performed by
A. Lucas test
B. Fehling's test
[✓ Iodoform test]
D. 2, 4 –DNPH

Q.29 $(CH_3)_3CCH_2OH \xrightarrow[180°C]{Conc.H_2SO_4} X$
The "X" compound in the above reaction
A. Isobutylene
B. 2–Methyl–but–1–ene
C. Isopropylene
[✓ It's not an alkene]

Q.30 Reaction of Phenol with bromine in polar solvent (H_2O) give
[✓ 2, 4, 6-Tribromophenol]
B. p - Bromophenol
C. o- Bromophenol
D. Mixture of o – Bromophenol and p - Bromophenol

Q.31 Which of the following is more acidic in nature
A. Carbolic acid
B. Benzoic acid
[✓ Picric acid]
D. Acetic acid

Q.32 Which one is NOT used for denaturing of alcohol
A. Methanol
B. Pyridine
C. Acetone
[✓ Alanine]

Q.33 2, 3- Dihydroxy butanedioic acid is also called
[✓ Tartaric acid]
B. Oxalic acid
C. Phenol
D. Lactic acid

Q.34 The IUPAC name of secondary butyl alcohol is
A. 1-Butanol
[✓ 2-Butanol]
C. 2-Methyl 2-propanol
D. n-Butanol

Q.35 Which of the following can be obtained by inorganic raw materials?

[✓ Methyl alcohol]
B. Ethyl alcohol
C. Diethyl ether
D. Phenol

Q.36 Which of the following compound shows maximum hydrogen bonding with water

[✓ Ethanol]
B. Phenol
C. Dimethyl ether
D. Cyclohexanol

Q.37 2-Bromopentane reacts with Alcoholic KOH to give

A. 1-pentene
B. 1-pentanol
[✓ 2-pentene]
D. 2-pentanol

Q.38 Which of the following decides the reactivity of alkyl halides?

A. C – C bond strength
B. C – H bond strength
[✓ C – X bond strength]
D. Electronegativity difference

Q.39 The mechanism involved the reaction, KOH + $C_2H_5Br \rightarrow C_2H_4$ + KBr + H_2O, is

A. S_N1
B. E_1
C. S_N2
[✓ E_2]

Q.40 Alkyl halides react with Mg to form Grignard's reagent. The order of reactivity is

[✓ $CH_3Cl > C_2H_5Cl > C_3H_7Cl$]
B. $CH_3Cl < C_2H_5Cl > C_3H_7Cl$
C. $CH_3Cl < C_2H_5Cl < C_3H_7Cl$
D. All have same reactivity

Q.41 The general formula for an alkanone is

A. $C_nH_{2n}O_2$
B. $C_nH_{2n+1}O$
C. $C_nH_{2n+1}OH$
[✓ $C_nH_{2n}O$]

Q.42 The alcohol which cannot be used to prepare an aldehyde by oxidation

A. Ethyl alcohol
[✓ Isopropyl alcohol]
C. Methyl alcohol
D. Neopentyl alcohol

Q.43 An alcohol giving positive 2, 4-DNPH test implies that

A. It is 100% pure
[✓ It may contain some contents of aldehydes and ketones]
C. It is ethanol
D. Alcohol contain some contents of carboxylic acid

Q.44 Reduction of an aldehyde using $NaBH_4$ gives

[✓ Primary alcohol]
B. Secondary alcohol
C. Tertiary alcohol
D. Phenol

Q.45 Acidified hydrolysis of cyanohydrins forms

A. Carboxylic acids
B. Alcohols
[✓ Hydroxyl-carboxylic acids]
D. Aldols and ketols

Q.46 Acetaldehyde can react with

A. Electrophiles only
●. Electrophiles and nucleophiles
C. Nucleophiles only
D. Free radicals only

Q.47 A compound which give both haloform and Tollen's test is

A. Methanal
B. Methyl ketone
●. Acetaldehyde
D. Acetone

Q.48 Unsymmetrical ketones on oxidation with strong oxidizing agent produces ______ carboxylic acids.

A. Same
●. Maybe same or different
C. Different
D. Ketones cannot be oxidized

Q.49 Benzaldehyde will not give which of the following reaction

●. Iodoform
B. Cannizaro's reaction
C. Silver mirror
D. 2,4-DNPH

Q.50 Cannizzaro's reaction is not given by

A. $HCHO$
B. C_6H_5CHO
C. $(CH_3)_3C\text{-}CHO$
●. CH_3CHO

Q.51 Which of the following show no reactivity with hydrazine

A. $HCHO$
●. CH_3OH
C. CH_3CHO
D. $(CH_3)_2CO$

Q.52 Acetone reacts with $NaHSO_3$ to form bisulphite adduct. This is an example of

A. Electrophilic substitution reaction
B. Nucleophilic substitution reaction
C. Electrophilic addition reaction
●. Nucleophilic addition reaction

Q.53 $CH_3 - CO - CH_2 - CH_3 + [O] \rightarrow C + D$ In the given reaction, C and D are

●. $CH_3COOH + CH_3COOH$
B. $CH_3COOH + CH_3CH_2CHO$
C. $CH_3COOH + CH_3CH_2COOH$
D. $HCHO + 2CH_3COOH$

Q.54 Methyl ketones are usually characterized by

A. Tollen's tests
B. Lucas test
●. Iodoform test
D. Fehling solution test

Q.55 Which pair of compounds cannot be distinguished by means of Tollen's test

A. $HCHO$ and CH_3COCH_3
●. $HCHO$ and CH_3CHO
C. CH_3CHO and CH_3COCH_3
D. $C_6H_5COCH_3$ and C_6H_5CHO

Q.56 In an acid catalyzed reaction of carbonyl compounds, the acid increases ______

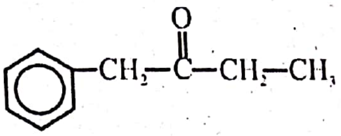
A. Nucleophilic character of C of carbonyl
B. Acidic character of carbonyl
●. Electrophilic character of C of carbonyl
D. Both acidic and nucleophilic character

Q.57 **Which of the following aldehydes is used to prepare urotropine medicine, which is used to control urinary track infection?**

A. Acetaldehyde ●. Formaldehyde

C. Acetone D. Ethyl alcohol

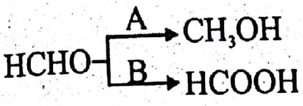
Q.58 **Correct name of the given compound is**



A. Benzyl propanone B. 4-Phenyl-2butanone

C. 2-Phenyl-2-Butanone ●. 1-Phenyl-2-butanone

Q.59



$$HCHO \begin{cases} \xrightarrow{A} CH_3OH \\ \xrightarrow{B} HCOOH \end{cases}$$

In gives reaction step A and B are _______ and ______ respectively

A. Oxidation, Hydrolysis ●. Reduction, Oxidation

C. Oxidation, Reduction D. Reduction, Hydrolysis

Q.60 **All of the following aldehydes are in the liquid state except**

●. Methanal B. Propanal

C. Ethanal D. Butanal

ANSWER KEY

1	D	11	D	21	A	31	C	41	D	51	B
2	C	12	B	22	A	32	D	42	B	52	D
3	B	13	A	23	B	33	A	43	B	53	A
4	A	14	A	24	D	34	B	44	A	54	C
5	C	15	C	25	B	35	A	45	C	55	B
6	A	16	C	26	C	36	A	46	B	56	C
7	C	17	C	27	B	37	C	47	C	57	B
8	D	18	D	28	C	38	C	48	B	58	D
9	B	19	C	29	D	39	D	49	A	59	B
10	D	20	C	30	A	40	A	50	D	60	A

10 UNIT

CARBOXYLIC ACIDS AND MACROMOLECULES

SELF ASSESSMENT TEST

Q.1 Which of the following is not carboxylic acid?

A. $C_nH_{2n+1}COOH$

[✓ B. $C_nH_{2n+1}OH$]

C. $C_nH_{2n}O_2$

D. RCOOH

Q.2 Pentanoic acid is

A. Maleic acid

B. Glutamic acid

C. Adipic acid

[✓ D. Valeric acid]

Q.3 Which one is not fatty acid

A. Palmitic acid

B. Stearic acid

[✓ C. Phthalic acid]

D. Oleic acid

Q.4 Isobutyric acid also written as

A. 2-Propanoic acid

[✓ B. 2-Methylpropanoic acid]

C. 2-Ethylpropanoic acid

D. Ethanedioic acid

Q.5 Which of the following compound cannot be oxidized to carboxylic acid by mild oxidizing agent:

[✓ A. Ethanol]

B. Propanone

C. Ethanal

D. Propionaldehyde

Q.6 Hybridization of functional carbon, changes from ______ to ______when converting to carboxylic from formyl

A. sp → sp

B. sp → sp^2

C. sp → sp^3

[✓ D. $sp^2 \rightarrow sp^2$]

Q.7 Ethyl cyanide boiled with HCl in the presence of water gives

A. Methanoic acid

[✓ B. Propanoic Acid]

C. Ethanoic acid

D. Butanoic acid

Q.8 A molecule is oxidized to simple aliphatic carboxylic acid if the molecule gives silver mirror but do not behave as an acid, identify the molecule

A. Butanol

B. Propanoic acid

C. Ethanol

[✓ D. Propanal]

Q.9 Hydrolysis of alkane nitriles for preparing carboxylic acids requires

A. Acidic conditions

B. Alkaline conditions

[✓ C. Any of the above]

D. Both are simultaneously necessary

Q.10 IUPAC name of CH_3CN is

[✓ A. Ethane nitrile]

B. Propane nitrile

C. Methyl cyanide

D. Ethyl cyanide

Q.11 $R-X+KCN \xrightarrow{\text{alcohol}} R-CN+KX$ **is an example of**

A. Electrophilic substitution reaction

B. Condensation reaction

[✓ C. Nucleophilic substitution reaction]

D. Elimination reaction

Q.12 Carboxylic acid decomposes bicarbonates with

[✓ A. Effervescence]

B. Esterification

C. Hydrogen

D. Reaction don't proceed

Q.13 Ethyl alcohol reacts with which to give a product having pineapple flavor:

A. Acetic acid

B. Valeric acid

C. Formic acid

[✓ D. Butyric acid]

Q.14 Which one is benzyl acetate

A. $C_6H_5CH_2COOCH_3$

B. $C_6H_5COOC_6H_5$

[✓ C.] $CH_3COOCH_2C_6H_5$

D. $CH_3(OH_2)_2COOC_2H_5$

Q.15 Esterification is a reaction

[✓ A.] Condensation

B. Neutralization

C. Elimination

D. All

Q.16 Which of the following do not give acetamide when react with ammonia

A. Carboxylic acid

B. Acid Chloride

C. Acid anhydride

[✓ D.] Alkyl nitrite

Q.17 Which one don't convert carboxylic acid to acid halide

[✓ A.] Cl_2

B. $SOCl_2$

C. PCl_5

D. PCl_3

Q.18 During the formation of an ester from acetic acid, what actually happens

A. Displacement of the H^+ from the acid by Cl

[✓ B.] Displacement of the OH^{-1} from the acid by OCH_3

C. Attachment of OCH_3 with the carbonyl oxygen

D. Displacement of the H^+ from the acid by OCH_3

Q.19 Carboxylic acid react with ammonia to form which salt

A. Acid amide

B. Acetic anhydride

[✓ C.] Ammonium acetate

D. Acetyl chloride

Q.20 Which of the following formula is more reactive for hydrolysis

A. $-COOR$

B. $-CONH_2$

C. $-COOH$

[✓ D.] $-COCl$

Q.21 $2CH_3COOH + Na_2CO_3 \longrightarrow X + CO_2 + H_2O$. **Identify "X" among the following**

A. Sodium butanoate

B. Sodium methanoate

[✓ C.] Sodium ethanoate

D. Sodium propanoate

Q.22 $CH_3COONH_4 \xrightarrow{heat} CH_3CONH_2 + H_2O$

Above reaction is an example of

[✓ A.] Dehydration

B. Polymerization

C. Hydrolysis

D. Condensation

Q.23 Ester used for banana flavouring is

[✓ A.] Amyl acetate

B. Ethyl butyrate

C. Isobutyl formate

D. Octyl acetate

Q.24 Which of the following metal does not react with carboxylic acid

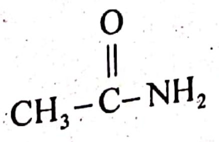
A. Na

B. Ca

C. K

[✓ D.] Cu

Q.25 IUPAC name of



$CH_3-\overset{\overset{\large O}{||}}{C}-NH_2$

A. Acetamide

B. Ethanal amine

[✓ C.] Ethanamide

D. Ethanal imide

Q.26 Pure organic acids are much

[✓ A.] Weaker than chloro substituted acids

B. Stronger than chloro substituted acids

C. Same strength as chloro substituted acids

D. Stronger than dichloro substituted acids

Q.27 Here the strongest acid is

A. CH_3COOH
[✓ B. $Cl-CH_2-COOH$]
C. CH_3CH_2COOH
D. $Br-CH_2-COOH$

Q.28 Carboxylic acid when dissolved in H_2O produces H_3O^+ and ________

[✓ A. Alkanoate ion]
B. Phenoxide ion
C. Alkoxide ion
D. Hydroxy ion

Q.29 Which of the following can react with $NaHCO_3$

[✓ A. Ethanoic acid]
B. Ethanol
C. Phenol
D. Water

Q.30 Which of the following does not contain COOH group

A. Succinic acid
B. Lactic acid
C. Adipic acid
[✓ D. Carbolic acid]

Q.31 The helical structure of secondary protein is due to

A. London force
B. Dipole force
C. Covalent bond
[✓ D. Hydrogen bond]

Q.32 Peptide linkage is chemically

[✓ A. Amide linkage]
B. Glyosidic linkage
C. Ether linkage
D. Ester linkage

Q.33 In an α-helix of secondary structure of protein, the hydrogen bond exits between

A. Carbonyl carbon and nitrogen of amine
B. α-hydrogen and carbonyl group
[✓ C. Carbonyl oxygen and hydrogen of amine]
D. All are possible

Q.34 The groups responsible for hydrogen bonding in proteins are

[✓ A. $>C=O$, $H-N<$]
B. $-OH$, $H-N<$
C. CHO, H_2N
D. COOH, H_2N

Q.35 Which enzyme bring about exchange in functional group between two compounds

[✓ A. Phospho-transferase]
B. Phospho-glyceromutase
C. L-asparaginase
D. LDH-1

Q.36 Which of the following acid is found in the stings of bees and ants

[✓ A. Formic acid]
B. Benzoic acid
C. Acetic acid
D. Phthalic acid

Q.37 Gelatin is obtained by heating

A. Bones
B. Skin
C. Tendons
[✓ D. All of these]

Q.38 When a carboxylic acid is protonated, protonation occurs at

A. Hydroxyl oxygen atom
[✓ B. Carbonyl oxygen atom]
C. Hydroxyl hydrogen atom
D. Carbonyl carbon atom

Q.39 Which of following cannot be directly prepared from acetic acid

[✓ A. Acetamide]
B. Acetic anhydride
C. Ethyl acetate
D. Acetyl chloride

Q.40 The reaction of acetic acid with sodium metal is

A. Nucleophilic addition
[✓ B. Electrophilic substitution]
C. Elimination
D. Nucleophilic substitution

Q.41 In glutaric acid $HOOC-(CH_2)_n-COOH$, the value of n is equal to

A. 1
B. 2
C. 5
[✓ D. 3]

Q.42 Which one is most acidic in nature

A. Propanoic acid
B. Acetic acid
C. Carbolic acid
●. Formic acid

Q.43 The highest melting point is of

A. C_4H_9COOH
●. C_3H_7COOH
C. C_2H_5COOH
D. All have same melting points

Q.44 The general formula of aliphatic carboxylic acid is

A. $(CH_2O)_n$
B. $(C_6H_{10}O_5)_n$
●. $C_nH_{2n}O_2$
D. $C_nH_{2n}O$

Q.45 Only first four members of aliphatic acids are soluble in water due to

● Hydrogen bonding
B. Ion dipole forces
C. Debye forces
D. London dispersion forces

Q.46 The name of compound $HOOC(CH_2)_4COOH$ is

● Adipic acid
B. Glutamic acid
C. Acrylic acid
D. Aspartic acid

Q.47 Carboxylic acid are converted into respective alkanes in the presence of

A. $LiAlH_4$
B. $NaBH_4$
●. HI/P
D. Zn/Hg+HCl

Q.48 Which of the following compound will convert acetic acid to acetyl chloride

A. NaCl
B. HCl
C. $ZnCl_2$
●. PCl_5

Q.49 Acetic acid undergoes reduction with $LiAlH_4$ to give

●. Ethanol
B. Methanol
C. Ethane
D. Methane

Q.50 Ethanoic acid reacts with ethanol to give

●. Ethyl acetate
B. Ethyl formate
C. Methyl acetate
D. Methyl ethyl ether

Q.51 The enzyme used locally to stop bleeding

A. Urease
●. Thrombin
C. L-asparaginase
D. Zymase

Q.52 What is obtained if n-Propyl acetate is boiled with aqueous sodium hydroxide

A. CH_3OH
B. C_3H_8
●. C_3H_7OH
D. C_3H_7COONa

Q.53 Which of the following is a cyclic carboxylic acid

●. Phthalic acid
B. Oxalic acid
C. Lactic acid
D. Succinic acid

Q.54 If amyl butyrate is added to a liquid, it will develop a flavor of

A. Banana
B. Jasmine
C. Pineapple
●. Apricot

Q.55 A polypeptide is conventionally called a protein if it has

A. Less than 10,000 amino acid units
●. Molar mass more than 10,000 (g/mol)
C. More than 10,000 amino acid units
D. Molar mass less than 10,000 (g/mol)

Q.56 The tanning of hides is
[✓ A. Precipitation of protein]
B. Hydrolysis of protein
C. Rancidity of fat
D. Condensation of amino acids

Q.57 Many enzymes contain a protein part and non protein part. This protein part is______
[✓ A. Apoenzyme]
B. Holoenzyme
C. Co-factor
D. Co-enzyme

Q.58 Which of the following enzyme has Fe^{+2} ions as co-factor
[✓ A. Chrome oxidase]
B. Phosphatase
C. Carbonic anhydrase
D. Glucose -6-phosphatase

Q.59 In formation of protein, carboxylic group of one amino acid and amino group of other amino acid condensed together to give:
[✓ A. Peptide linkage]
B. 1 → 6 glycosidic linkage
C. Ester linkage
D. β 1-4 Glycosidic linkage

Q.60 Which enzyme is used to catalyze the addition of ammonia, water or carbon dioxide to double bond
A. Phospho-transferase
B. Fumarase
[✓ C. Phospho-glyceromutases]
D. Succinic thiokinase

ANSWER KEY

1	B	11	C	21	C	31	D	41	D	51	B
2	D	12	A	22	A	32	A	42	D	52	C
3	C	13	D	23	A	33	C	43	B	53	A
4	B	14	C	24	D	34	A	44	C	54	D
5	A	15	A	25	C	35	A	45	A	55	B
6	D	16	D	26	A	36	A	46	A	56	A
7	B	17	A	27	B	37	D	47	C	57	A
8	D	18	B	28	A	38	B	48	D	58	A
9	C	19	C	29	A	39	A	49	A	59	A
10	A	20	D	30	D	40	B	50	A	60	C

POST-PREP ASSESSMENT

Q.1 Many enzymes contain proteinous part known as

A. Halo-enzyme
B. Co-factor
[✓ C. Apo-enzyme]
D. Co-enzyme

Q.2 Which enzyme helps to diagnose rickets and obstructive jaundice

A. Thrombin
B. Lactic dehydrogenase (LDH)
C. L-Asparaginase
[✓ D. Alkaline Phosphatase]

Q.3 Which of the following have highest value of electronegtivity

[✓ A. F]
B. Br
C. Cl
D. I

Q.4 17g of OH^- have________ moles of electron

[✓ A. 10]
B. 6
C. 5
D. 9

Q.5 Number of covalent and co-ordinate covalent bonds in CO are

A. 1-covalent, 2-co-ordinate covalent
B. 2-covalent, 2-co-ordinate covalent
[✓ C. 2-covalent, 1-co-ordinate covalent]
D. 3-covalent, 0-co-ordinate covalent

Q.6 The number of moles of CO_2 which contain 8.00gm of oxygen is

A. 0.75
[✓ B. 0.25]
C. 1.50
D. 1.00

Q.7 Correct order of melting point of P_4, Na, Mg, Al

A. Mg > Al > Na > P_4
[✓ B. Al > Mg > Na > P_4]
C. P_4 > Mg > Na > Al
D. Na > Mg > Al > P_4

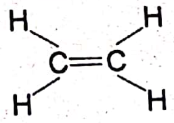
Q.8 Number of neutrons in $^{66}_{30}Zn$ will be

A. 30
B. 38
C. 35
[✓ D. 36]

Q.9 The maximum number of electrons in shells can be calculated by using formula

A. 2l+1
[✓ B. $2n^2$]
C. $2n^2+2$
D. $2n^2+1$

Q.10



Count the number of σ bonds and π bonds in the molecule

[✓ A. 1π and 5σ bonds]
B. 3π and 3σ bonds
C. 2π and 4σ bonds
D. 6π and 6σ bonds

Q.11 $\frac{1}{2}H_{2(g)} \rightarrow H_{(g)} \quad \Delta H = 218 KJmol^{-1}$

In this reaction ΔH will be called

[✓ A. Enthalpy of atomization]
B. Enthalpy of formation
C. Enthalpy of decomposition
D. Enthalpy of dissociation

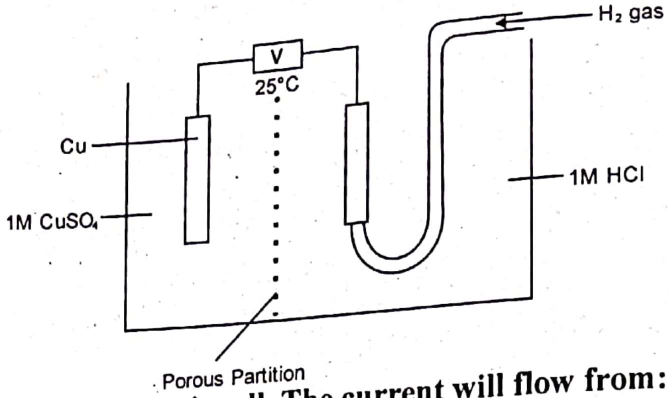
Q.12 $Mg_{(s)} + \frac{1}{2}O_{2(g)} \longrightarrow MgO_{(s)} \quad \Delta H = -692 KJmol^{-1}$ **at STP.**

Enthalpy of the above reaction will be called

A. ΔH°_{at}
B. ΔH°_{sol}
C. ΔH°_{n}
[✓ D. ΔH°_{f}]

Q.13 **Which of the following is least volatile**
●. F_2
B. I_2
C. Br_2
D. Cl_2

Q.14



The diagram shows a galvanic cell. The current will flow from:
●. Hydrogen electrode to copper electrode
B. Hydrogen electrode to HCl solution
C. Copper electrode to hydrogen electrode
D. $CuSO_4$ solution to hydrogen electrode

Q.15 **Study the following redox reaction:**

$$10Cl^- + 16H^+ + 2MnO_4^- \longrightarrow 5Cl_2 + 2Mn^{+2} + 8H_2O$$

Which statement is true about this reaction?
A. Manganese is oxidized from +7 to +2.
B. Chlorine is reduced from zero to -1
C. Chloride ions are reduced from -1 to zero
●. Manganese is reduced from +7 to +2

Q.16 **Value of K_{sp} for $PbSO_4$ system at 25°C is equal to:**
A. 1.6×10^{-5} mol²dm⁻⁶
●. 1.6×10^{-8} mol²dm⁻⁶
C. 1.6×10^{-6} mol² dm⁻⁶
D. 1.6×10^{-7} mol²dm⁻⁶

Q.17 **2A + B → Product**
If the reactant 'B' is in excess, the order of reaction with respect to 'A' in given rate law Rate = k[A][B] is:
A. 2nd order reaction
●. Pseudo 1st order reaction
C. 1st order reaction
D. 3rd order reaction

Q.18 **Velocity constant is the rate of reaction when the concentration of reactants is**
A. Zero
●. Unity
C. Two
D. Three

Q.19 **Melting points of group II-A elements are higher than those of group I-A because:**
A. Atoms of II-A elements have smaller size
B. II-A elements are more reactive
●. Atoms of II-A elements provide two binding electrons
D. I-A elements have smaller atomic radius

Q.20 **The ionic radius of fluoride ion is:**
A. 72 pm
●. 136 pm
C. 95 pm
D. 157 pm

Q.21 **Which solid does not have covalent bond**
●. Cu
B. P_4
C. S_8
D. I_2

Q.22 **Which halogen molecule 'X_2' has lowest dissociation energy?**
A. Cl_2
●. I_2
C. Br_2
D. F_2

Q.23 **The anomalous electronic configuration shown by chromium and copper among 3-d series of elements is due to:**
A. Colour of ions of these metals
B. Variable oxidation states of metals
[✓ C. Stability associated with this configuration]
D. Complex formation tendency of metals

Q.24 **Which element of 3-d series of periodic table shows the electronic configuration of $3d^8, 4s^2$?**
A. Copper
B. Zinc
C. Cobalt
[✓ D. Nickel]

Q.25 **The %age of nitrogen is ammonium nitrate is:**
A. 46%
[✓ B. 35%]
C. 82%
D. 13%

Q.26 **Conjugate acid of NH_3 is**
[✓ A. NH_4^+]
B. N_2H_6
C. NH_2^-
D. N^{-3}

Q.27 **Which one of the following reactions shows combustion of a saturated hydrocarbon?**
A. $C_2H_4+3O_2 \longrightarrow 2CO_2+2H_2O$
B. $CH_4+\frac{1}{2}O_2 \xrightarrow[400°C,200atm]{Cu} CH_3OH$
[✓ C. $CH_4+2O_2 \longrightarrow CO_2+2H_2O$]
D. $C_2H_2+\frac{5}{2}O_2 \longrightarrow 2CO_2+H_2O$

Q.28 **Consider the reaction given below:**

$$CH_3-CH_2Br \xrightarrow[alcohol]{KOH} H_2C=CH_2+HBr$$

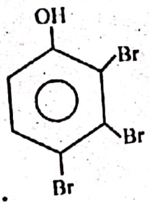
Mechanism followed by the reaction is:
[✓ A. E2]
B. S_N1
C. E1
D. S_N2

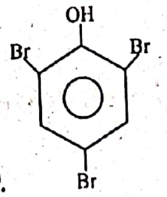
Q.29 **Which one of these is NOT a nucleophile?**
A. NH_3
[✓ B. BF_3]
C. H_2O
D. $\overline{C}H_3$

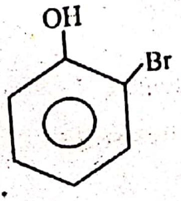
Q.30 **Which one of the following is an appropriate indication of positive iodoform test?**
A. Formation of H_2O
B. Brick red precipitate
C. Release of H_2 gas
[✓ D. Yellow crystal]

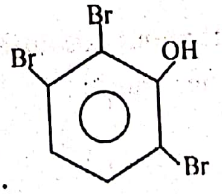
Q.31 **Isopropyl chloride is _______ type of alkyl halide.**
A. Primary
B. Tertiary
[✓ C. Secondary]
D. Polyhydric

Q.32 **Which one of the following is an appropriate structure of product of bromination of phenol?**

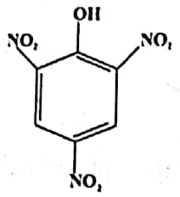
A.


[✓ B.]


C.


D.


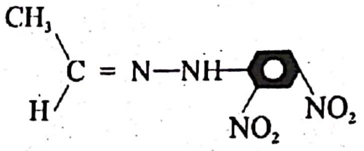
Q.33



Which one of the following is an appropriate name of above compound?

A. 1,3,6-trinitrophenol
B. Tartaric acid
C. m-nitrophenol
●. Picric acid

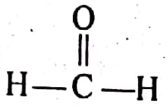
Q.34



It is a general formula of:

A. 2,4-Dinitrophenyl hydrazine
B. Phenyl hydrazone
C. 1,3-Dinitrophenyl hydrazone
●. 2,4-Dinitrophenyl hydrazine

Q.35 **Which one of the following is IUPAC name of the given structure?**



$$H-\overset{\overset{\displaystyle O}{\|}}{C}-H$$

A. Proopanaldehyde
B. Acetaldehyde
C. Methanone
●. Methanal

Q.36 **Which one of the following test is given by both aldehyde and ketone?**

A. Silver mirror test
●. 2,4-DNPH test
C. Fehling's solution test
D. Benedict's solution test

Q.37 **Which of the following contains most stable orbital in valence shell**

●. O^+
C. Mg^+
B. N^-
D. S^-

Q.38 **How many paired electrons are present in d subshell of element having atomic no 24**

A. 6
●. 0
B. 5
D. 3

Q.39 **Identify the gas with lowest density**

●. NH_3
C. Cl_2
B. CO_2
D. SO_2

Q.40 **Correct statement about absolute zero is**

A. All gases becomes liquids
C. Water freezes
●. Molecular motion ceases
D. All substance becomes solid

Q.41 **Strongest Van Der Waal forces among the following is**
[✓ Hydrogen Bonding]
B. London forces
C. Dipole forces
D. Debye forces

Q.42 **By changing which parameter the value of K_c could be changed**
[✓ Temperature]
B. Pressure
C. Catalyst
D. Volume

Q.43 **For decomposition of HI unit of K_c is**
A. $Moldm^{-3}$
[✓ No Units]
C. Mol^{-1}
D. $Mol^{-1}dm^{+3}$

Q.44 **Unit of rate constant is same as that of rate of reaction for ______ order of reaction**
A. 1st
B. 3rd
C. 2nd
[✓ zero]

Q.45 **Thermal energy at constant Pressure is called**
[✓ Enthalpy]
B. Internal energy
C. Work
D. Heat Capacity

Q.46 **Most Common oxidation states of halogen is**
A. +1
B. +3
C. +2
[✓ -1]

Q.47 **In 3rd series of transition elements which one of the following have same number of unpaired d electrons as present in Mn^{+2}**
A. Fe^{+2}
B. Cr^{+2}
[✓ Fe^{+3}]
D. Zn^{+2}

Q.48 **Select the organic compound that belongs to arene family**
A. Propane
B. Propanol
C. Methyl amine
[✓ Benzene]

Q.49 **Which of the following will show geometric isomerism**
A. Ethene
B. Propene
[✓ 2-Butene]
D. Butene

Q.50 **Type of isomerism which exist in a compound having molecular formula C_2H_6O**
[✓ Functional group isomerism]
B. Metamerism
C. Chain isomerism
D. Tautomersim

Q.51 **Electron deficient specie which is involved in formation of benzonium ion with benzene during sulphonation is**
A. SO_2
B. SO_3^+
[✓ SO_3]
D. NO_2^+

Q.52 When $-CH_3$ is attached with benzene then it makes the ring

A. Good Electrophile
B. Bad Nucleophile
C. Bad Electrophile
[✓ D. Good Nucleophile]

Q.53 In alkanes every carbon is usually _____ Hybridized

[✓ A. sp^3]
B. sp
C. sp^2
D. dsp^2

Q.54 Which of the following species is strongest conjugate base

[✓ A. RO^-]
B. $C_6H_5O^-$
C. OH^-
D. CH_3COO^-

Q.55 2-Butene when heated with $KMnO_4$ produces

A. Alkenes
[✓ B. Carboxylic acid]
C. Ketones
D. Amines

Q.56 Based on classification thyroxin can be classified as

[✓ A. Hormonal Protein]
B. Transport Protein
C. Structural Protein
D. Genetic Protein

ANSWER KEY

1	C	11	A	21	A	31	C	41	A	51	C
2	D	12	D	22	B	32	B	42	A	52	D
3	A	13	A	23	C	33	D	43	B	53	A
4	A	14	A	24	D	34	D	44	D	54	A
5	C	15	D	25	B	35	D	45	A	55	B
6	B	16	B	26	A	36	B	46	D	56	A
7	B	17	B	27	C	37	A	47	C		
8	D	18	B	28	A	38	C	48	D		
9	B	19	C	29	B	39	A	49	C		
10	A	20	B	30	D	40	B	50	A		

EXPLANATORY NOTES

(PAST PAPER QUESTIONS)

Q.1 Proteinous part of enzyme is called apoenzyme.

Q.2 Alkaline phosphate helps to diagnose rickets and obstructive jaundice.

Q.3 Order of electronegtivity is F>Cl>Br>I

Q.4 To calculate moles of electrons use formula
Moles of electrons= no of moles x electrons in single OH^- ions

Q.5 CO has 2 Covalent (1 sigma and 1 pi) and one coordinate covalent bond.

Q.6 Moles of CO_2 = mass in g/molar mass
Moles of CO_2 = 8/32=0.25

Q.7 Melting point is directly proportional to number of bonds
$Al > Mg > Na > P_4$

Q.8 Number of neutrons= Atomic mass – atomic number

Q.9 Maximum number of electrons = $2n^2$

Q.10 There are 5 sigma bonds(4 C-H and one in C-C) while one pi bond formed by sidewise overlap

Q.11 Enthalpy of atomization is the amount of energy absorbed to form one mole of atom

Q.12 1 mole of MgO is formed in the reaction so it will be enthalpy of formation

Q.13 Order of volatility $F_2>Cl_2>Br_2>I_2$

Q.14 Hydrogen will act as anode while Cu cathode so Hydrogen will transfer electron to Cu

Q.15 Mn^{+7} acts as oxidizing agent so it will get reduced to Mn^{+2}

Q.16 $PbSO_4$ will produce two ions so to find value of K_{sp} use the following formula
$K_{sp}= s^2$

Q.17 Whenever one of the reactant is taken in excess or is non-limiting reactant and other is in limited amount then the reaction will have pseudo first order of reaction.

Q.18 Velocity constant is the rate of reaction when the concentration of reactant is unity.

Q.19 Melting points of group II-A elements are higher than those of group I-A because II have two binding electron and will form more bonds as compare to IA.

Q.20 The ionic radius of fluoride ion is 136 pm.

Q.21 Cu is metallic solid so it will not have covalent bonds.

Q.22 order of bond dissociation energy is
$Cl_2 > Br_2 > F_2 > I_2$

Q.23 The anomalous electronic configuration shown by chromium and copper among 3-d series of elements is due to stability associated with the configuration.

Q.24 Element of 3-d series of periodic table shows the electronic configuration of $3d^8$, $4s^2$ is Ni

Q.25 The percentage of nitrogen is ammonium nitrate is 35% which is calculated by formula
%N= mass of N in compound/ molar mass of compound x 100

Q.26 Conjugate acid is formed when base gains a proton. When NH_3 gains proton it will form NH_4^+

Q.27 During Combustion of saturated hydrocarbon (methane) 1 mole of methane will burn in excess of oxygen to produce CO_2 and water.

Q.28 Primary Alkyl halide when reacts with Alc.KOH it produces alkene and shows E_2 reaction.

Q.29 BF_3 is electron deficient species it will be electrophile.

Q.30 Appropriate indication of positive iodoform test is the formation of yellow crystals of iodoform(CHI_3)

Q.31 Isopropyl chloride belongs to secondary RX.

Q.32 Bromination of phenol produces white ppt of 2,4,6 tribromo phenol.

Q.33 2,4,6- Trinitrophenol is also known as Picric acid.

Q.34 Given structure is 2,4-dinitro phenyl hydrazone.

Q.35 IUPAC name of formaldehyde is methanal.

Q.36 Only aldehydes reacts with mild oxidizing agents while ketone and aldehyde both reacts 2,4-DNPH because it is test to distinguish carbonyl and non-carbonyl compounds.

Q.37 O^+ has fully filled 2s and half filled 2p subshell so it will have most stable valence shell.

Q.38 Z=24 belongs to Cr which has $4s^1$ and $3d^5$ configuration that's why there is no paired electrons in 3d.

Q.39 Density is directly proportional to molar mass at same conditions. While NH_3 has lowest molar mass so it will have lowest density.

Q.40 At absolute zero Volume becomes zero and molecular motion ceases.

Q.41 Order of Van-der Waal forces

Hydrogen bonding> Dipole forces> Debye forces > London forces

Q.42 Value of K_c can only be changed by changing temperature.

Q.43 For HI, K_c has no units because number of moles of product is equal to number of moles of reactant.

Q.44 Rate of reaction and rate constant of zero order have same units which is $moldm^{-3}s^{-1}$

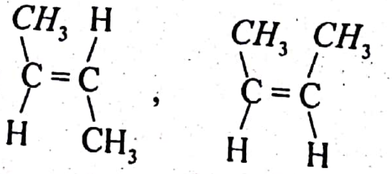
Q.45 Thermal energy at constant Pressure is called Enthalpy.

Q.46 Most Common oxidation state of halogen is -1.

Q.47 Mn^{+2} and Fe^{+3} both have same number of unpaired electron is d subshell. Both of them have 5 unpaired electron in d subshell.

Q.48 Arenes belongs to aromatic family that's why benzene is arene.

Q.49 1-Alkenes never shows Cis-Trans isomerism while un substituted 2-alkene always shows Cis-Trans isomerism



Q.50 Ethanol is a functional group isomer of dimethyl ether.

Q.51 Electrophile during sulphonation of benzene is SO_3.

Q.52 $-CH_3$ donates its electron density to benzene ring and makes it a better nucleophile.

Q.53 In alkanes every carbon forms a single bond that's why it will be sp^3 hybridized.

Q.54 Weakest acid forms the strongest conjugate base according to Lowry-Bronsted concept.

Q.55 Alkenes when treated with hot $KMnO_4$ produces carboxylic acid while in cold $KMnO_4$ it forms diols.

Q.56 Thyroxin is hormonal proteins.

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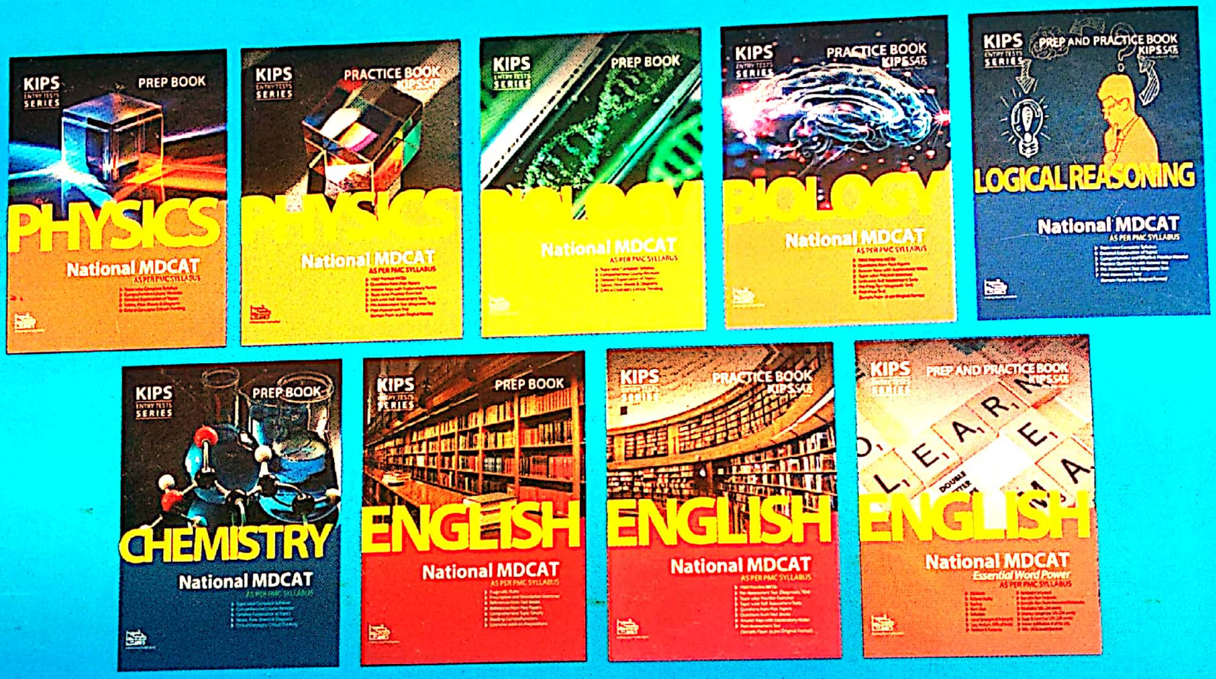

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